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BY JOHN A. BRITTON.

TESTING.
BY C. R. DELANEY.

IMPACT AND EROSION OF FALLING WATER.
BY B. A. ETCHEVERRY.

PROPOSED ENGINEERING EDUCATIONAL WORK AT THE STATE'S PRISONS.
BY ROBERT SIBLEY.

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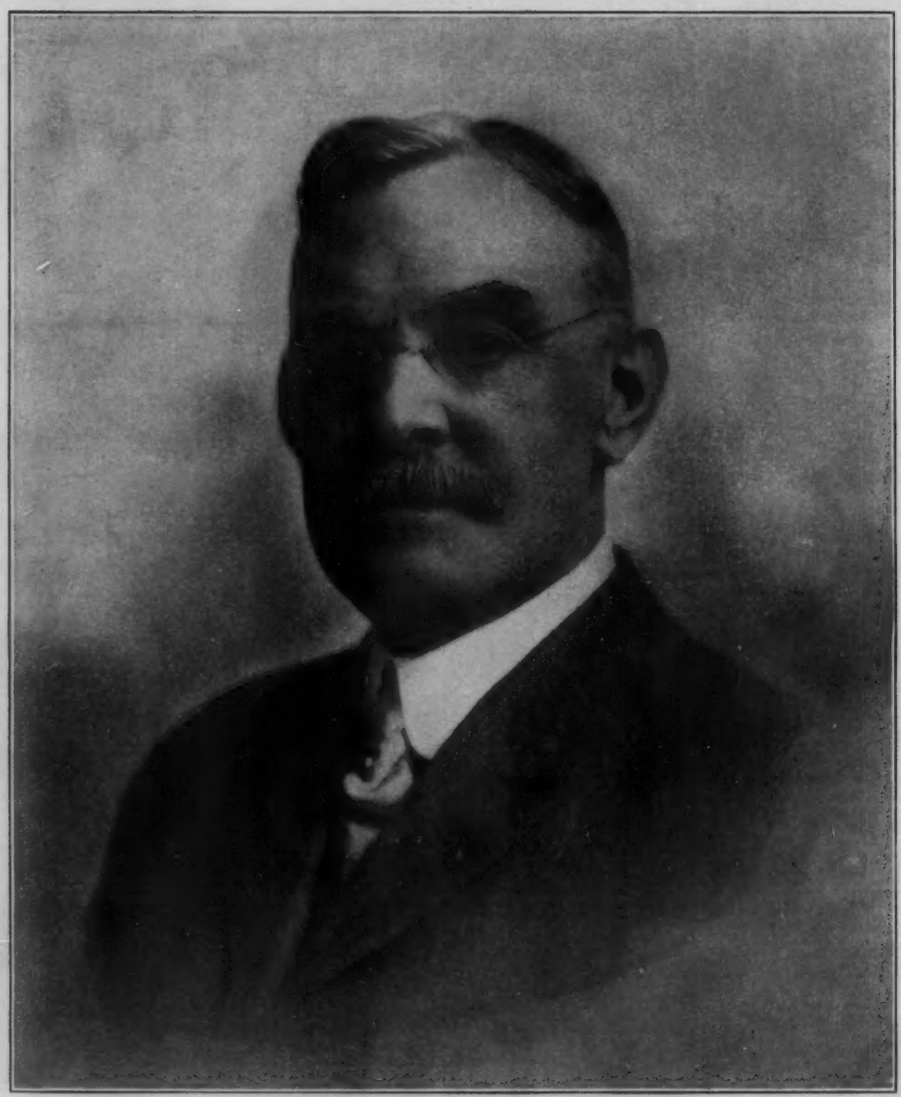

JOHN A. BRITTON
Vice-President and General Manager,
Pacific Gas & Electric Company

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POWER AND GAS
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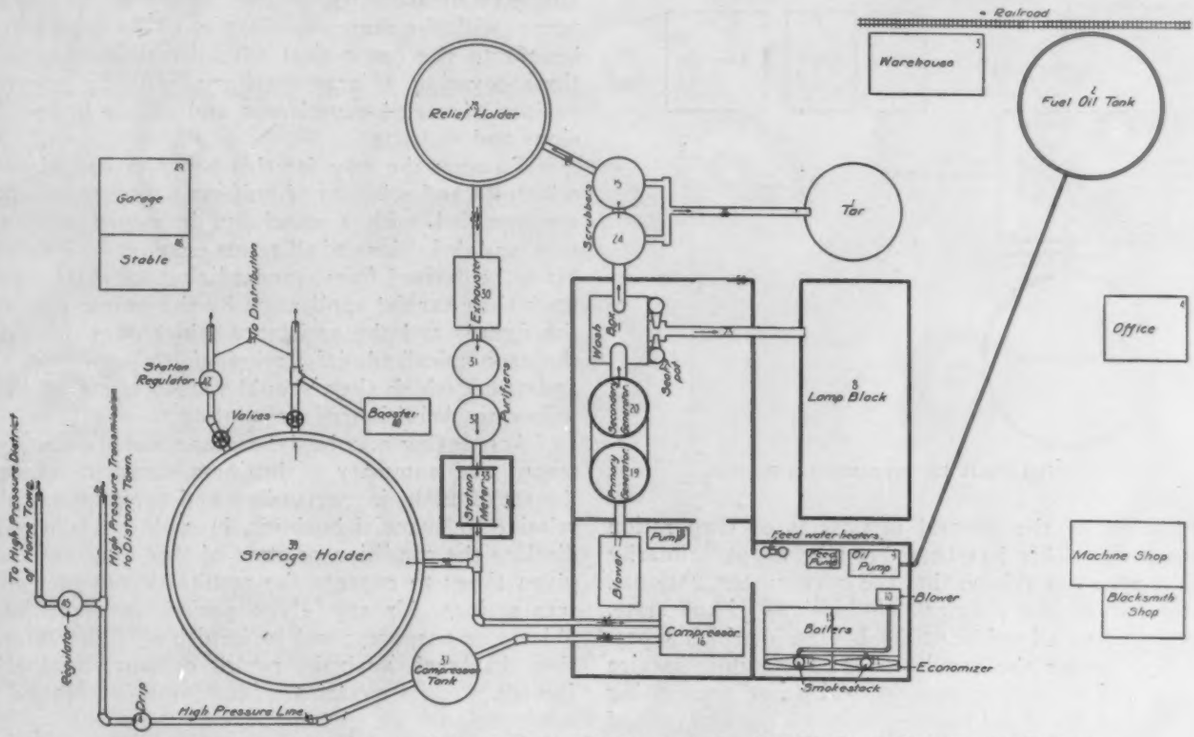
ACCOUNTING UNDER UTILITY REGULATION[1]

BY JOHN A. BRITTON.

I have been asked to speak on the subject of accounting as directly applied to Gas Engineering. At the outset I desire to differentiate between bookkeeping and accounting, for I would not wish for any aspiring engineer to become a mere bookkeeper, slave of the pen and pad, an imitator, or mere creature of debit and credit. But of accounting you should ployed as a guide and rule, subject always of course to human frailties, spells success, deviated from materially spells failure.

To insure accuracy, or mathematical precision, presupposes a knowledge of the equations that are the result of careful thought and keen analysis, and there is no training of an engineer that will better fit him



Details of Apparatus Used in the Generating Department of a Gas Works, Indicating the Refinements of Accounting Used.

and must be masters, else your work will fail of its greatest worth—accuracy.

"Accurate" is defined as "In exact or careful conformity to truth, or to some standard requirement the result of care or pains; free from failure, error or defect; exact."

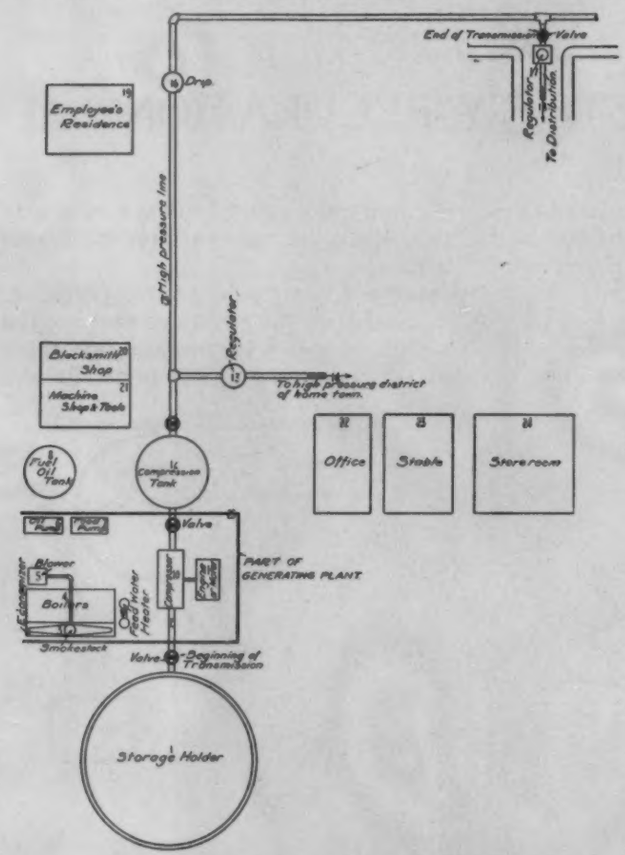
This definition aptly fits the requirement of an engineer in his dealings with the world, and if em- for the confidence of his clients and the public at large, than the superior knowledge of the classification of accounts.

The engineer of today is the factor in determination of the status of his client, before courts and commission, greater than the lawyer who pleads the case. Not only must he know the engineering details, and be familiar with the formulae that sustain his reason, but he must also fully know the data that tie them in to the particular part of the plant that he

[1]Lecture delivered before students in gas engineering at the University of California.

has made a study of. He must know its relation to the particular part of the account that it is chargeable to; he must know of the particular relation one to the other of sources of revenue, of the differential between capital accounts and operating, maintenance, replacements, distribution, general and administrative expense, as they each and all have a part to play in his determination of proper costs.

It is only of a very recent date that engineers have been compelled to acquaint themselves with the minutia and detail of account keeping, and to advise



Accounting Chart for Transmission Section.

themselves of the general intricacies of corporation accounting. This has been brought about primarily by the keen supervision that the government, national, state, and all the political subdivisions of the state, exercises over all public utility bodies, in which supervision is under the regulation of the public service utility acts in force in many of the states, prescribing the method, form and manner in which the accounts of all such corporations must be kept. It is not enough for a gas engineer to know the principles of his profession as applied to the mechanical or chemical branches, but he must be thoroughly familiar with the accounts that are prescribed for each branch, that he may on examination of, or reporting on an enterprise know accurately to which particular and peculiar phase of the accounts each item belongs.

This exactitude of corporation accounting, which is very rapidly becoming standardized all over the world, causes, so to speak, every man to express himself in the same language. There is no longer any uncertainties as to what is meant in these expressions. Formerly men in the gas world spoke many tongues and a convention of them was like unto the Tower of Babel, but experience has taught us the value of this standardization, and one plant must by its work stand comparison with the other on exactly the same basis.

Let us now consider the various divisions into which the capital invested in the plants of a gas company are divided. These may be classed as general, generating, transmission and distribution, and will be so treated in the following discussion. Illustration as shown herewith indicate the minute detail in which these segregated accounts are kept.

Accounting in General.

I will now read you excerpts from instructions issued by the Pacific Gas and Electric Company by its accounting departments to the several districts and divisions governing the question of accounting as applied to that company.

The desirability of uniform accounts as the basis of uniform reports, for the same classes of operations of industries, has been recognized by an ever-increasing number of accountants, economists, government officials and public writers. Past experience demonstrates, however, that if this uniformity is ever to be attained, it must follow the acceptance of a common language of accounts, or the use by all of common terms, with the same significance. This is of especial benefit to the economical administration of corporations covering a large territory, enabling the comparison of varied experiences and efforts in the divisions and districts.

To open the way for this common use of terms, schedules and schemes of uniform accounts should be accompanied with a carefully developed nomenclature, and definitions of all terms employed. The benefits to be derived from standardizing accounts, depend upon their careful application by the people compiling the figures and the assistance which they furnish in the economical administration of the business. The assistance which they should render is stated in the following definition of accounting:

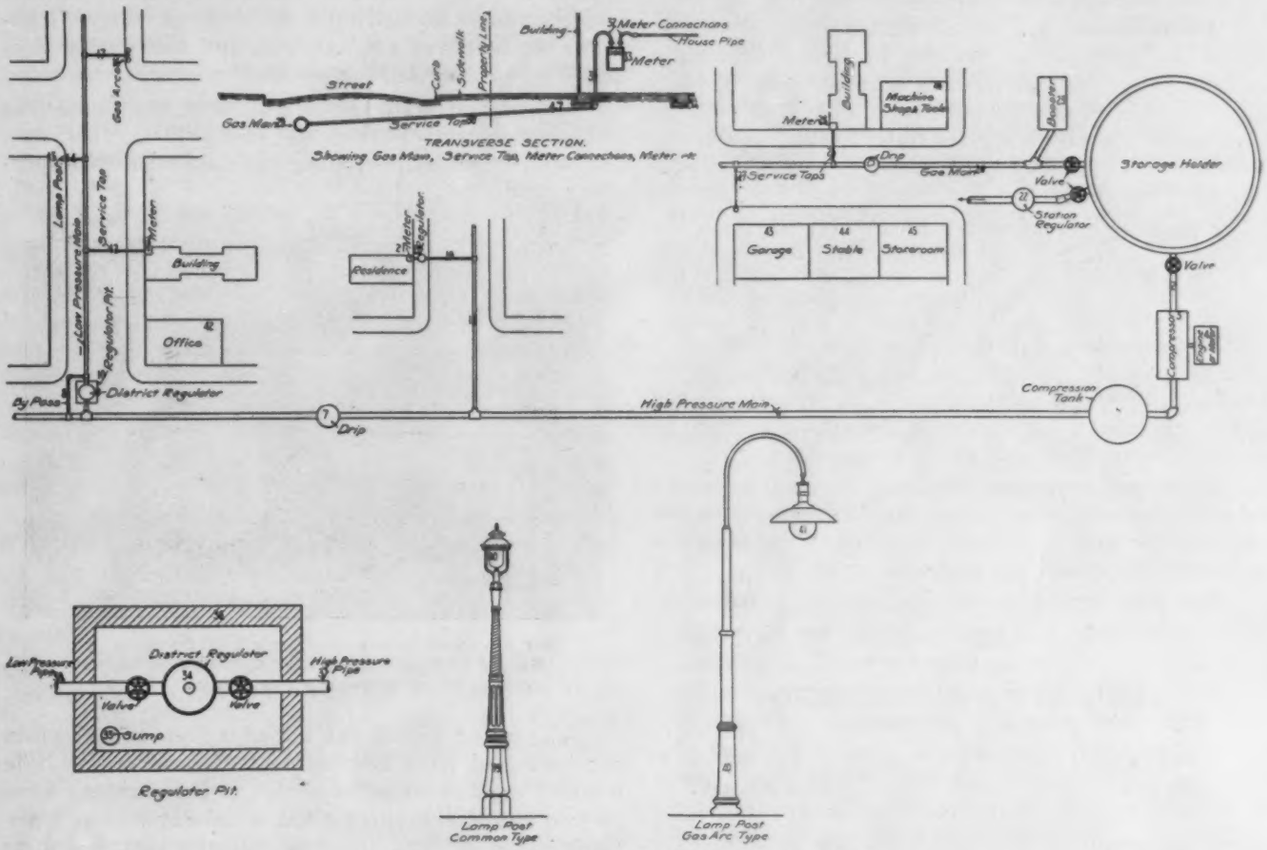
Accounting may be defined as a scientific analysis, record and summary of business transactions, or as the art of analyzing, recording and summarizing data, relative to financial business, in such a manner as to disclose the condition or state of that business at any given time; to express the results or outcome of its transactions, for any given period, in terms of its objects or purposes; and to furnish all other information that such analysis, record or summarizing can furnish, for its systematic and most successful administration.

In applying the science of accounting to the successful administration of a business or enterprise for gain, such as are all public service corporations, two principal classes of accounts are always employed. The first is known as balance sheet or general ledger accounts, and the second as gain and loss accounts. In addition to the two principal classes of accounts mentioned above, the greater number of public and private enterprises keep additional or supplemental accounts, to aid in furnishing other information, needed for their systematic and scientific administration.

These accounts of a public or private enterprise are its ledger accounts, in which are recorded the

financial data which, when properly summed up on a statement generally called a balance sheet, or statement of affairs, will present a correct exhibit of its financial condition at a specified time, by setting forth the value or amount of its resources or capital; the amount of the claim of its creditors, or liabilities; and that of the equities of its proprietors, or proprietary interests.

The gain and loss accounts of a business or enterprise conducted for gain are the accounts, which when properly summed up, disclose the results or outcome of its business operations, for a given period of time. These accounts may be called revenue and expense accounts.



Distribution Chart for Gas Works Accounting.

Definitions.

Except where some other meaning is clearly specified in the definitions of the accounts, the following words, wherever used herein, have the meanings below stated:

Cost means cash or money cost, and not price based on a term of credit.

Labor means human services of whatever character.

Cost of labor includes wages, salaries and fees, paid to persons for their services.

Cost of materials and supplies includes all specifically assignable transportation charges incurred in obtaining the delivery of such materials and supplies upon the premises of the purchaser and the cost of any special tests made thereon prior to their acceptance; also a suitable proportion of warehouse expenses (where the materials and supplies are passed through warehouses), and the cost of further transportation to the place of consumption, in which case a corresponding credit shall be made to the suitable expense account as herein provided.

Cost of repairs includes cost of labor expended and material consumed, less salvage, if any.

As the term is used herein, by **capital of a corporation,** is meant all property devoted to the tendering of the services, or the production of the commodities, which are within the purposes of the corporation.

Capital which has an expectation of life in service of more than one year, (exception being made of hand and other small portable tools, liable to be lost or stolen, and which are not listed as to number and location), is called **fixed capital.**

Capital other than fixed capital is called **floating capital.**

Fixed capital is divisible into general capital and departmental capital, **general capital** being that which is indiscriminately available for the use of two or more classes of operations, while **departmental capital** is that assigned solely or principally to a single class of operations.

Fixed capital is also divisible into landed capital and non-landed capital. **Landed capital** includes all interests in land (exclusive of improvements thereon), the term of which is more than one year. All other fixed capital is herein called **non-landed capital.**

Non-landed capital is divisible into intangible capital and tangible capital. **Intangible capital** comprises organization, franchises, patent rights, and all

other intangible property within the definition of fixed non-landed capital, as above stated. **Tangible capital** comprises structures and equipment having an expectation of life in service of more than one year.

Capital is also divisible into original capital, additions and betterments, as defined below:

Original capital is that put into service at the outset of an enterprise.

Additions include additional structures, facilities and units of equipment not taking the place of anything previously existing.

Betterments include the enlargement or improvement, giving greater capacity to existing structures, facilities, and units of equipment.

By revenues, are meant all amounts of money, which the corporation receives, or becomes lawfully entitled to recover for services rendered, for products sold, as gross profits on merchandise sold, or as a return upon its property, (or interests in property). Revenues are classified as operating revenues and non-operating revenues.

Operating revenues are those derived from the sale of products and merchandise, from services rendered, and from returns on property used by the person or corporation in its own operations.

Non-operating revenues are those derived as a return upon the property of the corporation in the hands of others or from interests in property in the hands of others. They may be sub-classified as rents, interest, dividends and miscellaneous.

Divisional revenues are those derived from the sale of products, services rendered, gross profits on merchandise sold, or returns on property (or interests in property), within the divisions or districts.

Gas Department revenue includes all revenue derived from the sale of gas for light, heat or power.

PUBLICITY A PARTNERSHIP.

BY R. B. MATEER.

Many central stations claim to believe in publicity, and each year endow liberally the leading journals of their cities in order that talks bearing on rates, franchises and regulations may appear side by side with reading notices, attempting in this manner to ward off hostile attacks that threaten the status of a public utility. Thus they endeavor to promote the political welfare of the corporation, but fail entirely to enlist the co-operation of the public by evading the spirit of partnership necessary for the successful operation of public utilities.

Capital cannot regard itself as the principal or sole partner. Labor and the public control the majority of the stock of any corporation, determined to conduct a successful business on modern principles, unhampered with the agitation and baiting which only results in extraordinary and unwarranted expense to all concerned.

The average corporation, with great possibilities for commercial development and capable of large earning power, passes through a period of hardship caused entirely by the capitalist, the promoter usurping sole authority, to the exclusion of labor and the public. Unearned dividends are demanded that stock given as a bonus for promotion purposes may possess a fictitious value and be unloaded on the most important member of the partnership—the public. Failure to recognize the fundamental principals of partnership results in the uneven distribution of the burden and spells ruin.

For the partnership to be harmonious, each must live and work with the other, respecting their rights that proper administration and publicity of a practical character be assured, resulting in winning the confidence and good-will of all consumers.

The public must learn that operating expenses and returns on investment must be derived from earnings; that rates must be fixed to return a reasonable sum on the investment actually placed in the property. Convince the public of a square deal and it willingly pays the charge demanded for service rendered.

Bearing in mind the partnership, it follows that publicity demanded is not that of a political character, but such as places before the eye data on actual operating conditions.

This Fellow Exhibits One Method of Publicity, but Hardly of That Kind Which Will Enlist the Partnership of an Energetic Community.

The miller desires the kilowatt hour consumption per barrel of flour and its cost of production. The foundry accountant is interested in the current necessary to mould and finish a ton of castings. The wire-cloth manufacturer is interested in the energy and its equivalent in cash per yard of finished product. The farmer, bent in intensive cultivation, figures on the outlay per season per acre foot of water. The dairyman, first driven by necessity to manual labor, later through economy of operation to steam and its auxiliary machinery, is readily converted to electric power, when the cost of separating his cream or the outlay per 100 pounds of butter is available.

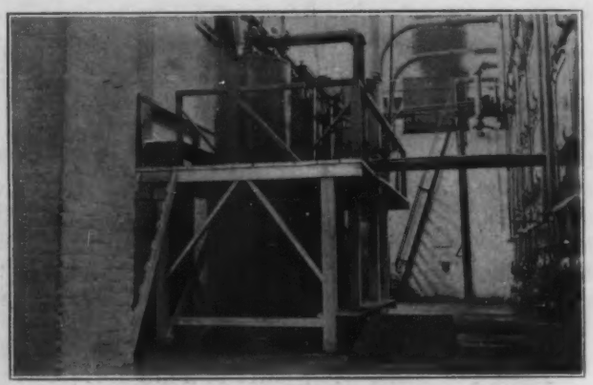
Data based on unit costs, published in the daily paper and accompanied with illustrations, will be an improvement over the general statements now found in print. Attractive folders mailed to the prospective customer, followed with energetic solicitation, is productive of the greatest returns per dollar outlay and promotes the interests of those forming the triune partnership. Publicity, otherwise termed co-operation, is productive of high efficiency, and is the direct evidence of a working agreement among partners, capital, labor and public.

SCIENTIFIC PLANT MANAGEMENT

TESTING. VI.

BY C. R. DELANEY.

It is customary to purchase machinery on the basis of certain guaranteed performances, and in order to find out whether these guarantees have been met, it is necessary to test the various machines after their installation. The test of the plant consists in weighing all water used for steaming purposes and all the fuel oil and making careful measurements of the kilowatts generated, by means of calibrated wattmeters, at the same time taking observations of temperature, pressure, drafts, etc. It is then a simple matter to calculate the pounds of water used by the turbine per kilowatt hour and the pounds evaporated by the boilers per pound of fuel oil, from which the efficiencies can be calculated. In testing the turbines it is usually



Arrangement of Tanks and Scales for Weighing Water in Steam Turbine Testing.

impossible to have all the conditions exactly the same as specified in the contract. For instance, the degree of superheat may be a little less than called for or the vacuum may run a little higher than called for in the guarantee, and it is necessary to make careful corrections to allow for these variations. It is also of great importance to make any corrections that may be necessary due to inaccuracies of the measuring instruments. The steam gauge must be carefully tested and compared with a standard gauge. A correction must be made for the exposed stem of the superheater thermometer. Thermometers are usually calibrated with the entire thermometer immersed at the time of calibration. In actual use there is always part of the stem of the thermometer exposed to the temperature of the room, and if the proper correction is not made for this, the thermometer may read 6 or 7 degrees lower than the actual temperature of the superheated steam. Corrections on the vacuum gauge are of still greater importance owing to the very great effect of a small variation in the vacuum. The barometer must be carefully observed, and its temperature and that of the mercury vacuum gauge must be noted. In all engineering work, a 30 in. barometer is used as a standard and the mean atmospheric pressure taken is 14.7 lbs. A mercury column 30 in. high is correct for a pressure of 14.7 lbs. only when the temperature of the mercury is 58.4 degrees, or say approximately 60 degrees. If a test is made in which the vacuum is measured by means of a mercury column close to the turbine, the temperature of the mercury in this column may be as high as 90 or 100 degrees and if the barometer reading is obtained from the Weather Bureau, who base all their observations on a temperature of 32 degrees, it will be necessary to correct both the barometer and the vacuum gauge to 60 degrees in order to obtain the true vacuum in the condenser. Failure to properly correct for temperature of the mercury columns sometimes means an error of .1 or .15 of an inch of vacuum, which would cause as much error as a mistake in weighing the water of 1200 or 1800 lbs. an hour. It is obvious, therefore, that it is useless to go to the expense of weighing the water, unless great care is taken in making all the observations. After a turbine has once been tested at its maximum capacity, its operation can be checked from time to time by allowing it to carry its maximum load. Owing to the fact that only a limited quantity of steam can pass through the nozzles of the turbine, it is obvious that if the machine is able to carry as great a load as the maximum obtained during the test, it is still operating at practically the same efficiency.

Fuel Oil.

In closing I would like to say a few words in regard to the immense advantage that we have on the Pacific Coast on account of the availability of oil fuel. A plant that is operated with oil fuel costs considerably less to build than a coal fired plant, owing to the fact that no stokers are required, no coal handling nor ash handling machinery have to be installed, and less draft is needed so that the smokestacks can be smaller and lower. Furthermore, much higher efficiency can be obtained with oil than with coal. It is possible to evaporate 15 lbs. of water per pound of oil, whereas with the character of coal available on the Pacific Coast, we could not expect an evaporation of over 7½ lbs. One lb. of oil, therefore, is equivalent to 2 lbs. of coal, so that 1000 lbs. of oil or 3 barrels, is equivalent to one ton of coal. At 80c a barrel, the 3 barrels cost us $2.40, and while it is possible to secure good coal in some Eastern cities at $2 or $2.50 per ton, the price of coal on the Pacific Coast runs as high as $8 or $10 per ton. Furthermore a very great saving in labor is effected by the use of oil fuel, so that it is safe to say that it does not cost us over one-third as much to operate our plants, as it would cost us if we had to depend on coal as fuel. The high extent to which boilers can be forced when burning oil, and the ease with which fires can be started up and stopped make oil an ideal fuel for use in a station that is operated as an auxiliary to a transmission system.

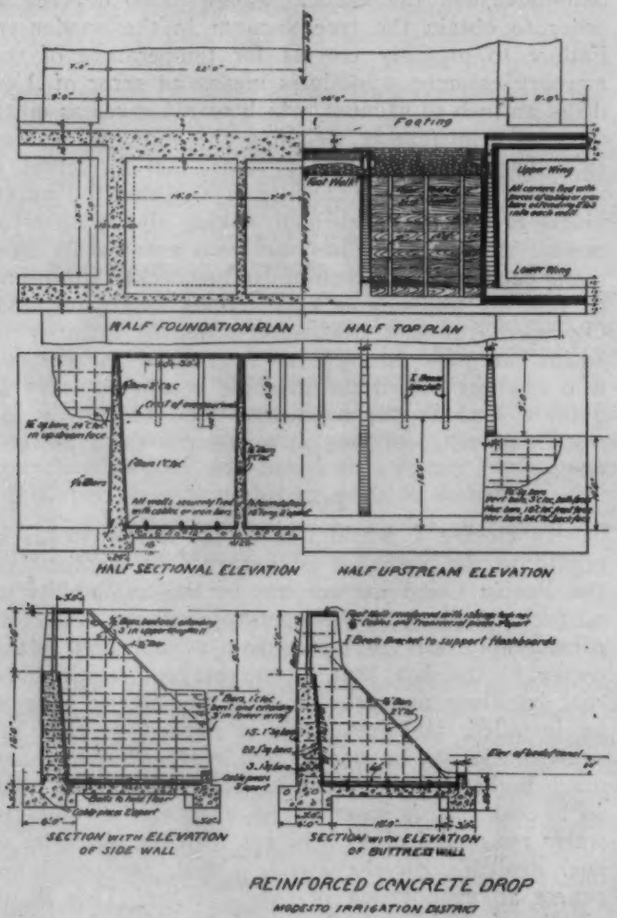
ELECTRICAL PUMPING AND IRRIGATION

IMPACT AND EROSION OF FALLING WATER.

BY B. A. ETCHEVERRY.

Downstream Impact and Erosion of Falling Water.—With notched drops this action is much decreased, the water being discharged in a fan-like shape. Three methods are used to resist this action: (a) By means of a strong floor; (b) by means of a water cushion; (c) by means of gratings or a baffle wall to break up the force of the falling water. These methods are generally used in combination.

(a) Floor of Falls.—The floor is generally protected by a water cushion. The thickness will depend



Typical Details of Concrete Drop.

on the character of the foundation, the depth of water cushion, the height of fall and the material used. Wood will resist impact and erosion better than concrete, especially when the water carries sand or gravel, and a wooden floor bolted to a concrete floor can be used to protect the concrete. The thickness of a concrete floor protected with a wooden floor or a water cushion should be made one-tenth of the height of fall, but not less than one foot. The length of the floor when no water cushion is used should be not less than three times the height of fall.

(b) Water Cushion.—The water cushion may be formed either as a depressed basin below the bed of the canal or as an elevated basin about the bed of the canal. The first method is generally used. To prevent eddies at the outlet of the basin the downstream half of the floor of the basin is sloped upstream. The depth of the water cushion is generally about one-third of the height of fall, and the length is made such that the falling water will strike at about the center of the basin. Beyond the downstream edge of the basin the floor should extend a distance equal to about one-half the length of the water cushion.

(c) Gratings and Baffle Wall.—Gratings or a baffle wall placed above the floor in the path of the falling sheet of water have been used to break up the force of impact. But the extra expense can better be applied to the construction of a good water cushion.

(d) Erosion Caused by Eddies at the Downstream end of the Floor.—Eddies occur when the channel formed by the side walls of the drop is smaller than the canal section, so that there is a change from a higher to a lower velocity. To prevent this erosion it is preferable to make the width of the channel formed by the side walls equal to the average width of the canal. For this reason it is often preferable to use either a raised crest or notches instead of a contracted length of breast wall. Where it is necessary to change from a contracted channel to the canal section, warped wings will give better results.

Design of Falls.—The parts of a fall are:

1. **The breast wall.**
2. **The upstream floor.**
3. **The downstream floor and water cushion.**
4. **The side walls and wing walls.**
5. **The upstream and downstream cut-off walls.**

The Breast Wall.—The breast wall is usually designed as a retaining wall, but for narrow drops can often be more economically designed either as a slab supported by the side walls or as a slab supported by the floor at one end and a beam forming the crest of the wall at the upper end. When a raised crest is used it is desirable to be able to drain the water held back by the crest, for this water will increase the water-logging of adjacent land. This is done by either providing drain holes in the crest at the level of the bed of the canal or by making at least a portion of the crest removable or adjustable by means of flashboards or gates. For a notched crest the principles discussed above must be followed.

The Upstream Floor.—The length of the upstream floor is generally short, and often the floor is entirely omitted.

The Downstream Floor and Water Cushion.—These have been previously discussed. They must often be supplemented by an extension of riprap or paving.

The Side Walls and Wing Walls.—The upstream wings prevent the water from washing around the structure. They should extend well into the banks.

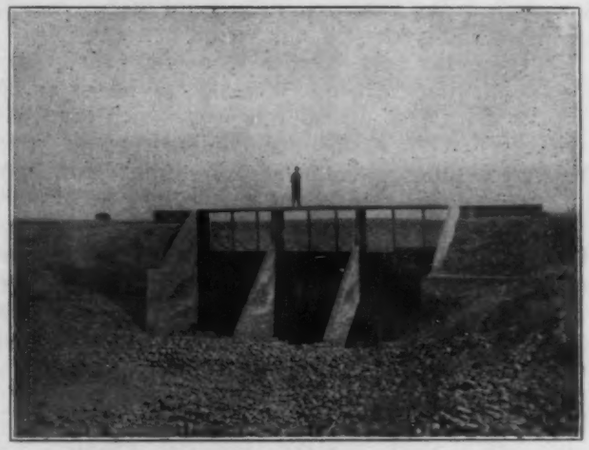
They may be placed at right angles to the axis of the canal or may form an angle of 30 to 45 degrees with this axis or may be warped surfaces. For an equal quantity of material a right angle wing will run further back in the canal bank. A warped wing or a wing placed on an angle guides the flow into the inlet, while a right angle wing will partly check the flow of water. This, however, is not objectionable in a drop. The side walls and downstream wings should guide the water in a straight course and prevent irregular currents. They also hold up the banks, and should protect the downstream banks from erosion. This is best obtained by making the distance between side walls on the downstream side of the breast wall equal to the average width of the canal and by extending the downstream wings well into the banks. The wing walls have earth pressure on both side. These pressures are usually unequal, but to a certain degree counteract each other so that the walls need not be heavy. The side walls, especially for high falls, resist high pressure and are designed as retaining walls.

Upstream and Downstream Cut-Off Walls.—The upstream cut-off wall is placed at the upper edge of the upstream floor, and is in the same line as the wing walls when right angle wings are used. It should extend below the bed of the canal to a depth of at least one-half the depth of water in the canal for ordinary soil, and deeper for very open soil. The downstream cut-off wall is placed at the lower edge of the downstream floor, and a depth equal to one-half that of the upstream wall is sufficient. Typical plans of drops are shown in the accompanying sketches.

Modesto Reinforced Drop.—The total fall is 11 feet, which is increased when flashboards are inserted at the crest. With the flashboards the structure can also be used as a check gate. The width of the structure between side walls is about the same as the bottom width of the canal. Between the side walls two piers or buttress walls divide the drop into three parts. Resting on these piers is a foot walk 3 feet wide and 4 inches thick, reinforced with 13 lengths of old ⅝-inch cable. Between the piers are 4-inch eye beam brackets to support the flashboards. These eye beams have the lower end imbedded in the concrete crest for 12 inches and the upper end bolted to the foot walk with two bolts imbedded in concrete. The buttress walls and eye beams divide the space above the crest into openings 4 feet 8 inches wide, regulated by means of flashboards.

To resist the erosive action of the water at the foot of the drop a shallow water cushion is formed by a toe wall 1 foot high; the crest of this toe wall is about 2 feet below grade, so that the actual depth of water cushion is about 3 feet. In addition a wooden floor is bolted to the concrete floor. This wooden cushion has proved very efficient, wood resisting erosion better than concrete. The wing walls above and below the drop run back at right angles to the axis of the structure, into the banks, acting as cut-off walls.

In building this structure the footings, foundation and floor were first constructed. Then the side walls, crest wall and wing walls were constructed. These walls were all tied to the foundation by means of pieces of old cable and steel from 18 inches to 3 feet long, spaced about 18 inches apart in double rows; one for each side of the wall and extending into the foundation at least nine or ten inches. All walls are reinforced with square steel bars. The corners are securely tied by pieces extending two or three feet in each wall. After the concrete was put in place the structure was very carefully puddled by holding water above the lower cut-off wall and puddling carefully while filling with the excavated material. The cost of building this structure was as follows:



Reinforced Concrete Drop, Modesto Irrigation District, California.

Excavation	$ 151.50
Gravel (including hauling)	280.00
Cobbles (including hauling)	170.65
Cement, 205 bbls, at $2.75	563.75
Hauling cement	62.50
Hauling lumber, etc.	150.00
Miscellaneous team work	38.65
Labor—concreting, riprapping	544.45
Labor—building form, placing steel	150.00
Labor—removing forms, plastering	40.00
Puddling	134.10
Storing lumber and outfit	36.00
*All steel (excluding cable)	329.65
Cook house supplies	280.15
Blacksmithing, rods, bolts, shovels	29.25
	$2960.65

*9182 lbs. of corrugated bars, 830 lbs. of steel shapes, 700 lbs. of old steel cable.

Volume of concrete—floor and foundation ... 86.5 cubic yards
Volume of concrete—superstructure .....108.5 cubic yards

195 cubic yards

Total cost of drop in terms of concrete used = $15.20

ELECRIC STREET RAILWAY CONSTRUCTION IN MEXICO.

The electric street railway now in operation, known as the Ferrocarril Electrico de Lerdo a Torreon S. A., which connects the three most important cities of the Laguna district, viz: Torreon, Gomez Palacio, and Lerdo, maintains several belt lines within the city of Torreon, a total trackage of 30 kilometers (18.6 miles). The manager of this line, Mr. Emilio P. Stein, of Gomez Palacio, Durango, states that the past year has been a most prosperous one and that, in addition to declaring the usual dividend of 12 per cent on the capital stock, there remains a tidy surplus for new construction and for the purchase of new equipment.

PROPOSED ENGINEERING EDUCATIONAL WORK AT THE STATE PRISONS.

BY ROBERT SIBLEY.

Since considerable publicity has been given to the recent inauguration of proposed university extension work in the state prisons, a word or two regarding its present status may not be out of order.

Some weeks back Warden Johnston of the Folsom state penitentiary wrote to President Wheeler an appeal for aid. This appeal was made with particular reference to certain prisoners who wished to better themselves during confinement in order that upon the expiration of their terms they might be of some use to themselves and to the state. As a number of the men have followed trades previous to their confinement they are desirous of improving themselves along such lines as mechanical engineering, structural work, and architectural design and particularly along the trade idea. In order to get a conception of the proposal at close range the writer went to Folsom on March 28th and there had an opportunity of lecturing before the entire eleven hundred prisoners and afterward engaged in personal conversation with some half a hundred convicts. The subject chosen for the lecture was an illustrated talk on The Great Engineering Feats of the West. The men seemed particularly interested in the discussion and many of them afterward told the lecturer that they personally had been engaged at one time upon various phases of the projects discussed.

To many the very mention of the name of Folsom, or of any state penitentiary, connotes the idea of a group of men scarcely human in their make-up, but to see these men as I saw them on last Friday instantly moves one to his very depths. Here one may see young men who have committed crimes in their early twenties after several years of confinement brought to the deepest appreciation and realization of life and its fullest meaning, awaiting only an opportunity to show the state their earnestness of purpose. As Warden Johnston states, it is his earnest aim to endeavor to inspire such men with ambition so that when they leave the prison they are at least no worse than when they entered and indeed by holding out to them an opportunity for improving themselves in spare moments to make useful citizens out of themselves instead of public charges as so often proves the case.

So far as I could judge in the few hours at my disposal none of the men are sufficiently qualified to engage in advance study in any branch of engineering but many of them are fully equipped with the practical side of the trades and indeed in many instances of the engineering professions. These men represent all stages of preparation and practical experience hence no unified course of instruction can possibly be made to apply to them. Here is a splendid opportunity for students in engineering at the university to aid in welfare work of this sort by assisting in individual effort, the proper guiding of the various classes of men. No more repaying work can be found for anyone inclined among welfare work than such opportunies as were shown me during my brief stay at Folsom.

No concrete plan has thus far been evolved even should any funds be available to handle the proposed extension work in the prisons. It would seem to me that the following outline might prove thoroughly practical:

That the prison authorities have some one on the grounds who could act as a local organizer and encourage the various men to help themselves—by helping themselves, I mean that among the prisoners are found men fully capable of helping the less informed. Some one at the university could then work in conjunction with the man upon the ground and encourage certain of the students who desire to engage in welfare work of this nature to take under guidance one or two prisoners and map out work to meet each individual case.

Such a plan would not only attain maximum results with the prisoners but would reflect in giving the student undertaking such work a deeper and more earnest realization of life and could not help but aid him in preparing for his own undertakings in life and at the same time hammer in still further the theoretical training he himself is getting at the university.

Our state prisons are releasing into the state from two to three thousand convicts every decade. That these men should go forth, if possible, with a fuller realization of life and that some hope of some sort may be inspired in their bosoms seems to me one of the greatest problems we have before us and the university will do well through its extension work in meeting this demand in every way possible. With no funds available at the present time it is difficult to plan just how this work may be undertaken, but the opportunity so fully exhibited surely will not be allowed to pass without our stretching forth the helping hand.

MUNICIPALLY OWNED STREET CAR SYSTEM IN AUSTRALIA.

At a special election on January 15, 1913, the citizens of Hobart decided to purchase the tramways (street car system) for $1,050,000. The vote favoring the proposition was about 4 to 1. The system includes a power plant and about 8 miles of track, which is limited to three lines running to three different parts of the city. The rolling stock consists of 28 double-deck cars, which cost $4000 each. It is the intention of the municipal council to make several extensions and improve the service generally. The old-style cars will be discarded and others of a more modern pattern substituted. The steam railways in Tasmania are already owned and operated by the state.

MEXICAN PETROLEUM OUTPUT.

The development of Mexico's petroleum industry is shown by the following statistics of output of crude oil in the past six years:

	Barrels.
1907	1,000,000
1908	3,481,410
1909	2,488,742
1910	3,332,807
1911	14,051,643
1912	16,500,000
Total	40,854,602

RAILWAY MOTOR AND CONTROL EQUIPMENT.[1]

BY A. A. MILLER.

It is a safe prediction that in the next ten years of our history remarkable results in the way of railway electrification will be accomplished and before many years electric railroading will be as prevalent as steam railroading is now. The steam locomotive will be supplanted by the electric just as effectively as the horse is by the self propelled vehicle. Every indications points in that direction. Money for electrification will be readily forthcoming—not in a rush, it is true, but in a gradual, dignified and irresistable manner—as certainly as the mark of time. And the key to the whole situation is efficiency of operation. We are all on the qui vive nowadays when anyone says "efficiency." The term "efficiency engineering" is one of new coinage brought about by the pressure of the demand for a greater realization of economy. A great many of our present methods in all businesses and professions are inefficient. How can the great element of waste be reduced? This is the burning question. And the railroad man is not the least disturbed individual about this matter. Operating men for the last three years particularly have been studying carefully the cost of operation of rolling stock, and as the result some radical changes in design of equipment and application of motive power have been found necessary. The weight question has received a maximum of attention, and whereas half a dozen years ago found the weight factor scarcely scrutinized, today, on account of it, we are in the midst of a wholesale change in the design of every part of the rolling stock. The efficiency of design of a motor car for city and suburban service is now judged largely by the net weight per seated passenger. Six hundred to seven hundred pounds per seated passenger are now considered about the best obtainable, and this figure has been realized by cutting out every pound of unnecessary material. Previous to this crusade against useless weight, we were quite satisfied with a thousand pounds and more per seated passenger. A comparison of the figures given readily shows what has been accomplished in the right direction. All steel construction for car bodies and the careful study of stress diagrams have produced structures surprisingly light considering the stiffness and rigidity obtained, which are much greater than were thought possible; the consequent resistance to crushing by the heavy impacts of collision and other accidents renders personal injury to the traveling public much less liable with resulting economy to the operating companies both by diminution of damage suit settlements and by lengthening the life of the car body—two points of primary importance.

Trucks, axles and wheels have all been carefully gone over to reduce weight as much as is consistent with required strength and a reasonable maintenance cost.

[1] A paper read before the Seattle Section of the A. I. E. E., February 18, 1913.

The last part of the equipment to receive attention of operators on the score of weight were the motors, and the question of whether or not a light weight motor is most economical has received especial attention.

An excellent contribution to the literature on this subject was made not long ago by Mr. F. E. Wynne, consisting of a paper read before the Baltimore Section of the A. I. E. E., entitled "Economies of Railway Operation." This appeared in the Institute Proceedings and is worthy of close study by those particularly interested. Mr. Wynne shows conclusively that to cut the weight of the motor equipment any considerable amount below that of standard types, that have existed for several years past, means a serious step in the wrong direction, as a light weight motor necessarily means one of high armature speed with resulting loss of power economy. A waste of power brought about by this means results in increased cost of operation. A careful series of tests have shown that the greater power saving obtained by a moderate speed motor (although it weighs somewhat more than the motor having a high inherent armature speed) was worth in that case more than twice as much as the cost of carrying around the excess weight of that motor. The fact was thus realized that little improvement in total weight can be effected by reducing the weight of the motor equipment.

One result of this realization has been the development of field control of railway motors and by this means surprisingly beneficial results have been obtained. Field control is not a new idea. On the contrary it was tried out years ago, but due to the commutation difficulties it engendered, it was necessarily abandoned and has lain dormant until the development of commutating pole railway motors with the attendant excellence of commutation under most severe and adverse conditions of service has again brought it to the front and rendered it a most practical method of obtaining a degree of flexibility not otherwise obtainable.

There are two methods of obtaining field control, one is by shunting the field winding with a non-inductive circuit and the other by cutting out a portion of the field winding. The latter method is the better one as it reduces liability of flashing at the commutator. Two field strengths are thus obtained with this method and two characteristic speed curves are secured, that with full field being lower than that with normal field. The torque per ampere is naturally higher with full field than with reduced field strength, and the current required in acceleration is correspondingly reduced. On all excepting the last series and the last parallel notch of the controller the motors operate with full field and are on resistance points. Both series and multiple running positions are, therefore, with reduced field and the motors operate on the higher speed characteristic. Note that the rheostatic losses are reduced on account of the accelerating current being cut down by the higher

torque derived with full field. Two ideal results are thus obtained with the same motor equipment (it should be noted these results cannot otherwise be secured)—first, most economical acceleration the same as would be obtained by using a slow speed motor and, second, high speed operation without gear ratio difficulties; in other words, the same effects are obtained as if an ordinary inherently slow speed motor were equipped with two gear ratios, one to give the highest tractive effort at the wheel tread in starting, with minimum current, and the other (a lower reduction) to be used for higher speed after the peak of the accelerating current had died away. Such a combination is, of course, only theoretically possible, as no serious attempt has ever been made (at least to the writer's knowledge) to effect a gear change on an electric car similar to the gear shifting mechanism of an automobile.

The use of a slow speed motor instead of a high speed motor in the example shown by Mr. Wynne reduced power consumption 10.9 per cent while the use of a slow speed motor and field control produces a saving of 19.5 per cent. This is largely on account of the fact that the resistance is all cut with the field control motor at a lower speed point (hence earlier in the acceleration) than it is with a slow speed motor not using field control.

The development of the commutating pole railway motor has been one of the most valuable events in electric railway history. It is claimed by some that the development of a motor ventilated by means of a fan on the end of the armature is an equal contribution to the art, but this is a badly exaggerated view as the standard motors of at least one American manufacturer have been well and sufficiently ventilated by the induced draught system for years past, which was accepted as a matter of course. No new principle was evolved, and, in fact, not even a new application of an old principle was made by putting a fan on the rear end of the motor armature thereby causing a longitudinal ventilation of the armature, but it has been so proclaimed. Exactly the same results had been secured for years past as is vouched for by the fact that the motors employing the same old ventilation method are guaranteed to perform the same service with the same temperature rise.

The old contention between d.c. and single-phase railway systems has fortunately subsided. It is a matter of history, a sort of reformation period. The single-phase system has gone and is still going steadily forward. It has come to stay and one cause of the subsidence of the controversy is this very fact. The use of a single-phase apparatus has not wrecked any road financially, where properly constructed and intelligently applied. We shall see larger and more important applications of it in the near future than we have in the past. The system of the New York, New Haven & Hartford Railway is a monument to the perseverance and skill of the engineers who designed, executed and operated the apparatus involved. Before long single-phase locomotives will pull trains all the way from New York to Boston on one of the most important railway systems in the world. The word failure is not in the vocabulary of single-phase terms.

ELECTRIC WELDING.[1]

BY W. M. PRICE.

Electric welding, so called, is the name given to the various processes whereby metals are so heated that their molecules can unite and form more or less perfect unions, either with their own kind or those of different metals. It is seen from this that electricity itself has no effect on the metal other than to heat it, and consequently the joints made with its aid are no different from those made with other heating methods with the exception that in some of the variations of electric work it is possible to eliminate oxides from the uniting particles and thereby make a more perfect joint than is possible with other heating mediums. This question is often asked by those unfamiliar with the facts.

All metals can be united by one or the other of the electric processes, although not any one process is capable of uniting all metals. Various sizes and shapes of similar or dissimilar metals can be united with the same limitations.

The metal forming the joints can be of the same kind and quality as that of the main pieces or it can be harder or softer or of different kind, as may be required. This work also has the limitations of the various processes.

Joints have a strength which is dependent on the process used, the filling metal if used, the original joining metal, and, to a certain extent, the amount of time used in doing the work and in the arc systems, the skill of the operator. This strength varies from 30 per cent with poor work to 90 to 95 per cent with the same area joined as the original pieces. If it is allowable to have additional area of joint with additional metal put on, the strength of joint will be over unity.

By means of the arc systems the work is not confined to making of joints only. Additional metal can be placed where weaknesses are shown, faults in castings repaired or missing portions made in place, worn or thin places built up, etc. The metal added can be, as stated before, of the same or different quality from the original pieces. It will be seen from this that worn places can be made better than the new by the addition of harder metal. New hard metal can be put on soft where the design of machinery requires it. Flat spots on car wheels can be repaired without grinding down the wheel other than to finish the repair, etc.

Electric welding is divided into two general forms, and each of these into several. The general forms are those of arc heating and resistance heating. The arc doing its work through the heat developed by a moderate amperage carried across the gap by a voltage of 60 to 125, the resistance doing its work by the heat developed by large amperage carried through the joining metals by means of low voltage. The arc systems are usually operated by direct current, and the resistance by alternating, although there is no reason that direct could not be used in the latter if it were not for the enormous current required at a very low voltage which would put the system out of commercial use if it were not for the fact that the alternating current can be readily changed to the required amperage and pressure. Owing to the difference in the heat of the

[1]A paper presented at the Seattle Section, A. I. E. E., January 18, 1913.

positive and negative arcs craters, the direct current gives the better results in many cases, although the alternating can be used.

Arc welding is the earliest of the various forms and dates, by patent record, from 1885 (No. 363,320, Bernados and Olzewski), although there was considerable experimenting done prior to this date. There was little practical work done by the earlier experimenters, due to their lack of knowledge of how to treat metals at the high temperatures generated by the electric arc. These experimenters took out patents on schemes designed to overcome their difficulties, these schemes being such as mechanical movement of the electrodes to prevent burning of the metal, working in vacuum, various compounds of materials used for fluxes, etc. The proposition has, however, gradually simmered down to a matter of skill of the operator, with his knowledge of the proper filling metal to use, and the working of this metal, the proper pressure and quantity of current, etc.

The three systems are nominally known under the names of those that were prominent in the early experimentation, or who took out the patents thereon. These are the Bernados, Slavinoff and Zeriner.

The Bernados system is that using a carbon as one electrode and the metal being worked on as the other, drawing the arc between. The voltage is usually 100 and the amperage dependent on the work that is being done, and varies from 25 to several hundred for use in heavy foundry work. In this process the operator, equipped with a hood over the head, and containing heavy colored glasses, through which to see, and which are to protect the eyes from the intense light, holds one terminal of the generator supply cable and to which is attached the handle of the carbon clamp. This is done with one hand and the other holds rods of filling metals, which are to be melted and joined with the pieces being repaired. The repair work is placed on a metal-topped table, which forms the other generator terminal. The arc is struck between the carbon and the work, and the heat of the arc melts the metal and the particles run together. As it is very seldom hammered, the nature of the weld is more like that of a casting. This process is very easy to learn to operate, and can be done by unskilled labor to a certain extent. This is the process that is also used as a cutting agency, although now being replaced by the oxyacetylene burners. This process can be used to do any work that is capable of being laid below the arc so that the melted metal of the work can unite with the metal of the rods used to fill holes and spaces and melted by being held in the arc.

The defects of the Bernados system are that it can be only worked on horizontal repairs, is very liable to make hard spots in the metal and due to the carbon of the electrode combining with the melted metal, and these hard spots are often too hard to machine, and due to the casting form of work the area highly heated is large and shrinkage strains are set up that cause future breaks unless the metal is of such form that it can take up without strain.

An improvement on the Bernados system was patented by Slavinoff in 1890, in which a metal rod was used in place of the carbon, thereby overcoming the objections to the hardness of the joint, and also making it possible to make joints and additions of the metal that is wanted. This was a very great improvement, and it was found that a reduction in the voltage and amperage also overcame the difficulties of strains as the local heating was materially reduced. Owing to the skill that is required in this process, however, it had very little commercial use until the last few years, when various experimenters took up the work and showed that it had value in certain classes of work. This system is the only one of the arc systems that allows of doing work whatever its location. For this reason it is almost as easy to do work over one's head as beneath his hand. As the work done by this system is usually of skilled labor, the quality of the joints is high, and 75 to 90 per cent is common strength. This is the system that is used for building up worn places, replacing missing parts, repair of boilers, tanks, etc. It can be used on any metal.

The third and last arc system is that known as the Zeriner, and also goes under the name of the electric torch. In this there are two carbon electrodes carried in a frame, in which is mounted a magnet, which is used to blow the arc down on the work, over which the torch is held. The heat of the arc does the work in the same manner as does the Bernados. Owing to the weight of the apparatus, it is only practical for small current capacities, and for light-weight metal, and has been almost entirely superceded by the O. A. burners.

It will be seen from the description of the arc systems that each piece of work is a separate proposition, and to be separately worked on, and quantity cuts very little figure. In the resistance systems, on the contrary, it will be noted that the work is done by machines, and that these are best adapted to certain forms, and consequently quantity of work of one kind is a requisite.

There are two forms of the resistance system—the butt and the spot. The butt welder is a machine that embodies a transformer which has its low pressure terminals connected to the two pairs of jaws of two vises, which are arranged with one stationary and the other movable toward the stationary one. The jaws are of copper and water-cooled in all of the larger machines, in order to take away the heat due to the resistance of the joint between the jaws and the metal therein held. The two pieces of work, being fastened in the vise jaws, are pressed together, and the current turned onto the primary of the transformer. In a few seconds the joint is hot enough to allow of being closed up by means of pressure applied to the movable vise. The current is cut off and the work is ready to be finished under a hammer, and which finishing is usually necessary to get rid of the fins. The primary voltage of the transformer can be made of any value; the secondary is usually 4 to 6. The wattage depends on the size of the work, a ¼-in. rod requiring about 3 kw. for three seconds' application, a 1-in. rod 30 kw. for 20 seconds and a 2-in. rod 75 kw. for 45 seconds. The strength of joint made with this type of machine depends on the metal that is joined. Low carbon steels, iron, etc., show up very well with 85 to 95 per cent strong joints. Special steels do not do as well, although this system will weld them better than any other.

In butt welding it is imperative that the area of the joining surfaces be the same or that the larger be

preheated, so that when the current flows the two will come to the welding heat at the same time. If this is not done the smaller will be always burnt and the joint of little value.

The other form of the heat welder is that known as the "spot welder," in which the same scheme of large current and low voltage is used (although the voltage in this machine is usually slightly higher on account of the higher resistance off the joints) and the weld caused through the heating, due to the large current. In this case the current is led to the metals through copper tips, likewise water-cooled, and when the metal is sufficiently softened is pressed together, thereby forming a weld. Owing to the amount of pressure being comparatively small and the copper points of small area, this system is not adapted to very heavy work, and is usually used on material of sheet form of ¼-in. and less in thickness, although there are machines that will do 1 in. with good results. The strength of the spot welded joint is greater than a rivet of equal area, and has the advantage that there is no hole-cutting or punching, and is done in much less time. The time required on No. 10 metal is 1:5 seconds with a power demand of 20 kw. The machine is best adapted to manufacturing work, but is better adapted to jobbing than is the butt welder.

There is another form of the heat welder that is seldom seen, as there are difficulties in its use that limit it strictly to manufacturing. This is the seam welder, where the current is led to two copper wheels that travel along the joint, and make the weld in the same manner as does the spot welder. This is only adapted to light gauge sheet metal that has been well cleaned of scale. It is used in putting coffee spouts in place and other similar work.

There are various adaptations of the resistance welding machines, and each machine adapted to special work. For instance, there is a machine that is used to make the joints in kitchen boilers and requiring about 1¼ minutes to do the work. There are a number of forms of machines for making various kinds of chains and links. Wagon axles are made of three pieces of metal, two round for the wheels and the other square of larger area and joining them. This is often done in a welder, and reducing the cost materially. Twist drills are made of two pieces of metal, one fluted and the other plain. The two joined make the cutting portion of the drill and the other the shank. In this work the cutting edge is often of better material than the shank. Taps are made the same way. Those of you who have autos will find that your mudguards are spot welded to the frames that support them, etc.

From the standpoint of the station man electric welding is not of very great value, nor will it bring in much income. This is due to the low load factor of all of the systems and the lower power factor of the butt and spot welders. The Bernados arc system is perhaps the best for the power man, as its demand is fairly steady when in actual use. The Slavinoff is very intermittent on all work requiring maximum strength of work. The Zeriner would be good if it were in use. The butt and spot welders have such a small time use of the current and low power factor that they are not satisfactory load. The power factor is from 65 to 75 per cent. The demands depend on the areas of the joints.

There is one form of what might be called an electric welder, although the actual joint is made on an anvil. This is the Burton electric forge, patented in 1897. In this the metals are put into a tank filled with a soda solution, and the current carried through the metals. The heat of the hydrogen gas liberated and burnt soon brings them to a working heat, and they are then taken to the anvil and worked as required. The small amount of data obtainable shows that 6 kw. d. c. require 1 minute to heat a 1-in. square rod; a ¼-in. section rod was heated in eight seconds.

Costs of welding by electricity are very much lower than by any other system, that of the arc being the most expensive, owing to the skill that is required and the wages of the operators. It can be done with equal strength at about half the cost of gas welding. Butt welding and spot welding can be done in any kind of quantity at from 5 to 15 per cent of the cost done in any other way, provided that the work is of the class that can be well done by the method used.

SOME FUNDAMENTAL PRINCIPLES IN TELEPHONE PLANT DESIGN.[1]

BY A. H. GRISWOLD.[2]

The fundamental principles on which telephone plants are designed are, first—to provide satisfactory communication between individuals separated by a definite distance, and second—to provide this satisfactory transmission at a minimum ultimate cost.

A telephone plant may roughly be divided into two broad parts—the long distance lines or the toll system, and the local or exchange system. The design of the toll system as far as physical construction is concerned does not differ materially from the design of any pole line carrying any other utility, except in so far as the telephone transmission is concerned. This problem of transmission is one of the most difficult in the telephone art, and is in itself a considerable problem. Accordingly, I will confine my remarks to the design of local or exchange plants and attempt to give you only some of the basic principles involved.

There is in any city a fairly definite relation between the population and the number of telephone subscribers, and such a ratio will be found to hold fairly constant with probably a slight continuing increase. Therefore, in laying out a telephone plant, the first thing to determine is the population. This is obtained from past census reports and accurately plotted and extended about 15 years hence, taking into consideration the reasons why the city might or might not grow at a faster rate or slower rate than it has done in the past. As a check, commercial bodies, city officials, officers of other corporations and representative citizens, are interviewed and their opinions obtained. It is probably needless to state that, if a correct answer is desired, it is generally necessary to discount their estimates by a considerable amount. Against this curve of population there is plotted a corresponding curve of growth of telephone subscribers. In this manner a very reasonable forecast of the future devel-

[1]Paper read before the San Francisco Electrical Development and Jovian League.

[2]Plant engineer of the Pacific Telephone & Telegraph Co.

opment at various future periods is obtained. A map of the city is then taken, and on this map is placed the estimated location of the subscribers in about fifteen years. A fifteen year period is used because this is the average life for the principal portions of the plant, and it is as far ahead as conditions can be reasonably predicted. In making this estimate, it is, of course, necessary to study very carefully each section, each block and often each house or building, and make the best possible forecast as to what kind of business will ultimately be required. In other words, the present and future possibilities are considered. If a manufacturing section is being considered, it will be determined probably that comparatively few telephone lines will be required, there simply being a few trunk lines from some telephone central office to large private branch exchanges. On the other hand, if it is a block in which there are or probably will be located large office buildings, a very high telephone development may be expected. In the same manner, in considering residence districts, the character of the district and of the houses is considered, it being generally known that the larger and better areas use individual lines, while the cheaper areas use party lines almost exclusively.

Having plotted the location of these subscribers, the next point to be considered is the wire center. By wire center I mean the point at which, if the office is located there, the average length of a subscriber line from the central office to the subscribers station will be a minimum. This wire center will sometimes fall in the heart of the business district, due to the generally heavy telephone development in that area. Real estate at reasonable prices is, therefore, not always obtainable at the wire center, and accordingly it may prove more economical to establish the central office a little off the wire center rather than to pay an excessive amount for the real estate. In other words, the excess cost of the real estate must be balanced against the distortion in the wire plant. This, of course, can be and is equated in dollars and cents.

We have thus far determined the location of the subscribers within each block, and from that, the location of the wire center or central office. The next point is the consideration of how to bring the subscribers into the central office at a minimum cost. Obviously, it is more economical to carry one large cable from the central office out to a certain district and distribute from the cable to the various subscribers, rather than to bring an individual pair of wires from each subscriber into the central office. The physical conditions encountered in the city, the character of the streets, whether paved or unpaved, etc., are considered, and main backbone routes, providing always a minimum distance to the central office, are established, and a map, or what is termed a fundamental plan, drawn showing these various routes all centering at the wire center or central office. This fundamental plan furnishes the general basis for a continually efficient construction program for any exchange area so that each step may be based upon the most complete possible understanding of all the available data and the possibilities involved. Whenever any important construction or reconstruction work is undertaken, it is necessary to decide certain questions for which a fundamental plan gives the best information, and if a satisfactory plan is not available it is necessary to base the decision on some of these questions upon an incomplete understanding of the factors and a considerable amount of pure conjecture. Fundamental plans are also necessary as a guidance to prevent the adoption of plant or traffic methods which will prove unsuited to the conditions of a growing system, and the indications of a fundamental plan are often of assistance in considering certain commercial problems. The answer must cover not only the present condition or a short time estimate of growth, but the probable later conditions in order that temporarily cheaper expedients are not adopted with later large losses, due to the fact that the method chosen is not adapted to the growth of the plant. When a business or legal arrangement is to be entered into, binding the company for a long period to certain rates for certain kinds of service, the telephone company should have as good an indication as possible of the probable number and distribution of future subscribers because these may be so different from the present that a rate which would be remunerative at present would finally produce too small a net return or even a loss. Such questions as these all can be answered intelligently with the help of a fundamental plan, and if such a plan is not made, the answer must be based on incomplete understanding of many of the factors. These fundamental plans are reviewed and brought up-to-date whenever the growth seems to indicate that modifications are necessary. In general, the period for review is once in about every five years.

Some of the uses of these plans are also as follows:

If you had 25 subscribers in a certain area at this time, and 15 years hence you estimated that there would be 100 subscribers within that same area, you would not place a 25 pair cable to feed that area because immediate relief would be necessary, nor would you place a 100 pair cable because that cable would not reach its full efficiency for fifteen years, but knowing the cost of installing cables and knowing fairly well about how that area will grow, you can balance the cost of plant against the growth and determine the economical size and period for the cable to be installed, and very probably you will find that something like a 50 pair cable which will last five years is the economical size.

Again in constructing a central office building, it is economical to build it large enough to care for the equipment for about eight years, and at that time extend the building to care for future periods.

Again in placing equipment in central offices, you ordinarily install enough to last two or three years, and so on for each type of plant.

Therefore, an adequate fundamental plan, together with the estimate of growth of telephones, are used as a guide whenever any important construction is contemplated, and each piece of plant that is added, is placed with a definite end in view and with a knowledge, if the predictions have been carefully made, that it will form a part of the ultimate and economical whole and therefore that minimum ultimate cost will accrue which, of course, is fundamentally essential in the proper design of telephone or any other type of plant.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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The Convict and his Usefulness in Engineering

To visit any of the great state penitentiaries of the West and to talk individually, one by one, with the unfortunates there confined is to have the human heart-strings touched as perhaps few experience in the usual even-running course of life. But putting aside all matters of sentiment and propounding the question of ultimate welfare to the state, the entire problem is one of serious concern. In central California, for instance, are located two of the world's greatest universities graduating annually some seven hundred students. Approximately to the west and to the east are two state penitentiaries graduating annually some four hundred convicts. The real problem for solution, then, is to bring about the mathematical verity of numbers arranged in proportion of which all are familiar, namely: "The product of the extremes should be equal to the product of the means."

Considered from the standpoint of most vital interest to the state, the problem is not one of pity for the unfortunate convict, nor sympathetic aid to the downcast. It concerns the very well-being of the body politic.

Warden Johnston of the Folsom penitentiary recently appealed to the state university of California in an effort to have some aid extended to such of those convicts as earned by exemplary behavior and general demeanor the privilege of improving their time during spare hours looking toward fitting the convict for some real usefulness when thrown again upon his responsibilities.

It so happened that it fell to the lot of the chief editor of this journal to make the preliminary investigation of the new problem. The details of this experience may be found on another page of this issue.

One of the prisoners in talking to a representative of the San Francisco Bulletin some days later thus described his impressions of this preliminary work:

"Only a few days ago the warden had a professor from the Univerisity of California give us an illustrated lecture on mechanical engineering. It was one of the most interesting things I ever heard. The professor showed viaducts, bridges, culverts, dams and all kinds of structures and pointed out the difficulties surmounted by engineers. I was not only interested in the subject, but when I was thinking about it in my cell that night I thought, 'Why can't you surmount difficulties, too?'

"Do you see the lesson I got?

"The professor offered to send books to any man who wanted to study the subject, and the warden is going to have similar lectures on other interesting and vital things right along."

After the lecture followed a personal, individual chat with some half a hundred men that had manifested a desire to improve their moments of relaxation. An electrician here, a molder there and an inventor yonder indicated in unmistakable sincerity a desire to undergo any sacrifice if only another opportunity in life would present itself whereby he might be given a chance to take his share of the world's burden from a fair start.

In Montana splendid results are being attained in prison reform. Good roads for that state are being built, ambition is inspired in the convict, his usefulness as a possible producer is heightened, and the

general standard of citizenship is consequently being raised.

Under the new system of parole in California some good results are being attained. The greatest object to the state under any scheme inaugurated should be that these men when set at liberty do not go out hardened criminals, or at least do not go out worse than when they entered confinement.

Without ambition or hope in life how can it be expected that these released convicts can become anything but incompetent, lazy, dissipated public charges? No truer saying could ever be held out to the convict than "while there's life there's hope." In the trades allied to the engineering profession thousands of these men could find a profitable and honorable livelihood. Ample opportunity for laboratory practice is available at every prison ground. Such as are ambitious and willing to seek self-improvement at the sacrifice of leisure hours should be given the opportunity. No greater welfare work for the state is possible than this, and on the other hand no more appreciative service that touches the heart through and through could ever be attempted.

Considered from the business standpoint, from the view of greatest good to the state, divorcing all possible benefit individually to the convict the helping, uplifting hand sent by western state authorities to their state prisoners could not be exerted in a worthier cause. In this helping attitude, engineering and the kindred trades will undoubtedly offer a valuable aid.

Wanted: Slogan for Electrical Development

Two great qualities of sound have through all ages thrilled and moved mankind to action. The first, music, when played in martial strains has urged men forward upon the field of battle even in the face of instant death, and when gasping for final breath of life the plaintive strain of a mother's evening hymn, "Home, Sweet Home," heard in memory's vision, has called the warrior once again to life and action. The slogan or battle-cry, too, has ever, from the earliest dawn of history, played a dramatic role in the rise and fall of human accomplishment. The West and her traditions are closely interlinked with the persevering cry of the hardy pioneer, "do or die," "Pike's Peak or bust," and countless other stirring war cries of the forty-niner.

Today a great commercial struggle is upon us. The gigantic growth of the electrical industry bids well to sweep everything before it. Indeed, its grim and determined backers have decreed that it must. Years ago philosophers meditated over the profound subject: "What's in a name?" and even Shakespeare or some other notable writer on human character, propounded the time-honored saying, "give a dog a bad name and you may as well kill him."

It is not a dog that is to be named this time, however, but an organization whose subtle force is so all powerful that the ancients reversed the spelling and called it a god for whose name and attribute we now search.

There is wanted by the Society for Electrical Development, Inc., some trade mark and slogan, or, if you please, a war cry by which this young giant of recent creation may sweep everything before it.

A cash prize of two hundred dollars for suggesting such a trade mark and slogan for popularizing the national use of electricity has been offered by this society. An attempt to win this prize is indeed worthy of thoughtful consideration by our best and brightest engineering intellects. Suggestions should be marked "Slogan Contest" and addressed to The Society for Electrical Development, Inc., 29 West 39th street, New York.

Many different types of slogans will undoubtedly be suggested. An emblem, typifying at a glance the greatest purposes of the society with an inscription below, significant of the campaign to popularize electricity may prove a prize winner.

To move men to action, to drive the business home, we must, however, have a slogan that immediately catches the fancy of the layman, enthusing and overcoming every obstacle such, for instance, as the now much hackneyed expression, "you push the button, electricity does the rest."

The fortunes and results of this new thought of organized electrical development will reach and be shared alike by all interested in affairs electrical the nation over. It is to be hoped that some Western man may solve the happy slogan.

True Success in Engineering

To help another attain what we ourselves have missed does indeed spell for a life's work the magic word success. In the keen struggle of life many failing of a college technical education have fallen by the wayside under the keen edge of competition or survival of the fittest. Those, however, who have weathered the storm, like the giant sequoias in the rocky, wind-blown Sierra, stand forth indomitable in strength of character, capable of withstanding every human onslaught. That such men should be imbued with a burning desire to impart their hard-earned experiences to the young is indeed one of the most wholesome signs in the present day evolution of the engineering profession.

Many instances may be cited in Western engineering practice where real sacrifice of money and time and physical effort has been made on the part of the older brother in engineering to help the beginner. An incident of present sacrifice is that of a group of Western men engaged in a great utility who are giving of their money, their time and their physical effort, purely and unselfishly to help the beginner without any thought of recompense or reward. One of the lectures of these men appears as our leading article of this issue. Some issues back a lecture of another one of these men appeared in the columns of this journal. That successful men, though not college gradutes, thus contribute in university halls data of the utmost importance to our engineering profession is indeed an indication of the present day close linking of the university and the technical business world.

But to those men themselves, who give unselfishly of the best within them, the engineering profession owes much and the young, ruminating upon life and its real worth, may thus see emblazoned in livid words true success in engineering.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

T. H. Bibber, of Edwards & Company of New York City, is at San Francisco.

H. D. Betts, vice-president of Thomas & Betts Company, of New York, is at Seattle.

W. M. Doming, of the General Electric Company, has returned to the East from California.

H. B. Vanzwoll of the Sunbeam Incandescent Lamp Company will be in Seattle about the 15th of April.

W. d'A. Ryan, illuminating engineer of the General Electric Company, is at San Francisco from Schenectady.

E. M. Cutting, Pacific Coast manager for the Electric Storage Battery Company, is visiting the Pacific Northwest.

A. J. Myers, Pacific Coast manager for the Wagner Electric Manufacturing Company, has returned to his San Francisco office from Nevada.

C. Runnell, manager of the light and power department of the British Columbia Electric Railway Company of Vancouver, is at San Francisco.

A. L. Thorn has been succeeded as superintendent of light and power for the Tacoma municipal plant by **B. W. Collins**, Mr. Thorn occupying the newly-created position of commercial manager.

F. G. Baum, chief engineer of the Pacific Gas & Electric Company, spent the past week at the new Lake Spaulding development, where work will be now vigorously prosecuted when the weather moderates.

A. P. Davis, chief engineer, United States Reclamation Service, has returned to Washington, after completing an extended tour of the West in an inspection of several of the Government irrigation projects.

Robert Herzog, chief hydraulic and electrical engineer of the Great Northern Railway, is at Riverside, Washington, in charge of construction on the Chelan River power plant, which is being built by the Great Northern.

B. W. Collins, superintendent of electric works; **A. L. Thorn**, commercial agent; **John Bird** of the Kendrick Electric Company, and **David T. Dickson**, of Evans-Dickson Company, have been selected by the city council of Tacoma to establish power rates for the city.

C. L. Cory, professor of electrical engineering at the University of California, Berkeley, Cal., and **A. J. Thaler**, professor of electrical engineering at Montana State College, Bozeman, Mont., have been transferred to the grade of Fellow in the American Institute of Electrical Engineers.

W. L. Goodwin, vice-president and general manager of the Pacific States Electric Company has returned from a trip to the Portland and Seattle houses and announces the Seattle establishment has now fully recovered from the effects of the recent fire and will be in readiness for active business operations April 1.

Frank G. Drum was elected president; **John A. Britton**, vice-president and general manager; **A. F. Hockenbeamer**, second vice-president, treasurer and comptroller; **D. H. Foote**, secretary and assistant treasurer; **J. C. Love**, assistant treasurer; **Charles L. Barrett**, assistant secretary of the Pacific Gas and Electric Company at the annual meeting on April 8.

H. A. Lardner, Pacific Coast manager for J. G. White & Company, has returned to his San Francisco office after conferring with officials of the San Joaquin Light & Power Company regarding their new developments. **F. W. Gay**, mechanical engineer with the company, has completed an investigation of conditions for the turbo-generator plant at Bakersfield, of which **Robt. Brisbane** will have direct charge. **C. J. Rodin**, hydraulic engineer for the company, is at the site of the new development on the Tule River.

C. P. Guertler, formerly engineer in charge of construction of the Redondo plant of the Pacific Light and Power Corporation, is now in charge of construction of the Marconi Wireless Telegraph Company's big new towers at Honolulu, which are to communicate with similar towers on the California coast at Bolinas and Tomales, where **K. C. Weeden** has charge of construction, all this work being performed by J. G. White & Co.

Geo. Hewins, formerly superintendent of construction at the Crane Valley dam and recently in charge of J. G. White's construction at Mt. Hood for the Portland Railway, Light & Power Company, has left for a two weeks' trip east, after which he will return to California to become general superintendent of construction for the new developments of the San Joaquin Light & Power Company, which are being carried on by J. G. White & Company.

J. D. Ross, superintendent of the Seattle lighting department, announces that a 10,000 kw. steam plant is to be installed by the department. There will be 8-625 h.p. boilers feeding 2-500 kw. turbine sets. Steam heat will be used in the Denny-Furhman and Capitol Hill districts. These are two of the finest residence and apartment house districts in the city. The plant is to be situated on the east shore of Lake Union, accessible by either water or rail.

P. S. Biegler, professor of electrical engineering at the University of Montana, Missoula, Mont.; **L. B. Cramer**, electrical engineer Oregon Electric Railway Company, Portland, Ore.; **John B. Fisken**, superintendent light and power system Washington Water Power Company, Spokane, Wash., and **Edgar A. Wilcox**, commercial agent Great Shoshone and Idaho Consolidated Power Company, Twin Falls, Idaho, have been transferred to the grade of member in the American Institute of Electrical Engineers.

C. P. Backstrand, assistant at Riverside Electric Light Plant, Riverside, Cal.; **J. P. Cahan**, assistant civil engineer Western Canada Power Company, Vaucouver, B. C.; **M. L. Cox**, electrical construction for Pacific Gas and Electric Company, San Mateo, Cal.; **E. A. Creilin**, inspector of overhead construction Portland, Eugene and Eastern Railway Company, Portland, Ore.; **T. M. Snell**, electrical distribution engineer Pacific Gas and Electric Company at San Mateo, Cal.; **G. F. Springer**, electrical engineer Puget Sound Traction, Light and Power Company, Bellingham, Wash., and **A. C. Whitmore**, switchboard operator Madison River Power Company, Norris, Mont., have been elected associates of the American Institute of Electrical Engineers.

MEETING NOTICES.

Portland Jovian Luncheon Club.

Captain T. B. Steele, formerly attorney for Thomas A. Edison, gave a most interesting talk on Mr. Edison's life and work at the regular lunch of the Portland Jovians. F. D. Weber presided.

Oregon Society of Engineers.

The regular meeting of the Oregon Society of Engineers was held at their club rooms, 247½ Stark street, on April 10, 1913. Mr. Marshall Dana, associate editor of "The Oregon Journal," delivered an address on "The Press and the Professions."

Seattle Jovian League.

The John A. Roebling Sons Company, Seattle, furnished the entertainment at the Seattle Jovian League luncheon April 4. A splendid quartette rendered several appropriate selections, and the meeting was addressed by Mr. Foster, president of the Seattle Carnival Association. He spoke on the forthcoming Potlatch, and urged that the Jovians put

forth every effort to make the festival a success. The chief feature of the carnival this year will be the electrical pageant, and the Jovians intend living up to the opportunity which the occasion will offer.

The Southwestern Electrical & Gas Association.

The ninth annual convention of the Southwestern Electrical & Gas Association will be held at Galveston, Texas, May 21, 22, 23 and 24. In addition it has been found necessary to have "parallel sessions" for the gas members and accountants, these to "parallel" regular sessions which are on subjects not interesting to those attending the gas and accounting sessions. One full session will be given to the "Supply Men," who have promised that it shall not be the least interesting session of the convention. This will be followed in the evening, with a Jovian "Rejuvenation," at which the National Deities will preside.

Electrical League of Southern California.

The Electrical League of Southern California, which meets each Tuesday at the Angelus Hotel, has arranged the following program for April, 1913:

April 8th—Dr. Norman Bridge, "The Mexican Situation."

April 15th—Southern California Edison Day.

April 22d—O. H. Ensign, Chief Electrical Engineer U. S. Reclamation Service, "Power Development and the Reclamation Service."

April 29th—Woodill & Hulse Electric Company Day.

On Tuesday evening at 7:30 o'clock the Westinghouse Company invited the Electric League to a pool tournament to be held at their old location at 524 South Spring street.

Oregon Technical Club.

E. A. West was chairman at a meeting of 100 members on April 1st, when an "April Fool's Day" program was presented. The following program has been arranged for the month: April 8th—Jos. Jacoberger, chairman. Speaker, R. L. Sabin, of the School Board. Subject, "Schools as Social Centers." April 15th—Ellis F. Lawrence, chairman. Speaker, A. L. Peck, of the Oregon Agricultural College. April 22nd—J. E. Davidson, chairman. Speaker, Guy W. Talbot, president Pacific Power and Light Company. April 29th—C. F. Blake, chairman. Speaker, Dr. Elliott of Reed College. After the 1st of May the luncheon day will be changed to Monday. The luncheons will continue to be held at the Portland Commercial Club.

San Francisco Electrical Development and Jovian League.

The regular monthly business meeting was held Tuesday last. Reports of the various standing committees were read and adopted.

The San Francisco Committee on Electrical Matters reported favorably on the proposed ordinance regulating electrical installations within the city and licensing master electricians. The ordinance is to come before the board of supervisors within a day or two for consideration. Notice was given of proposal to amend the constitution and by-laws of the League so as to provide for a legislative committee in addition to the other standing committees and extending the term of office for which the president and vice-president shall serve from six months to one year.

NEWS OF WASHINGTON PUBLIC SERVICE COMMISSION.

The commission has entered an order fixing the value of the properties of the Whatcom Railway & Light Company at Bellingham at $2,150,000. The values have been classified as follows: Railway system, $1,100,000; power and light system, $750,000; gas system, $300,000.

Application has been made by the Puget Sound Traction, Light & Power Company to put into effect without the usual statutory 30 day notice a rate of 1¾ cents per kilowatt hour for "mercantile business having at least 250 kilowatts of day load throughout the year, guaranteeing $10,000 per minimum, bills based upon a ten year contract." The commission is investigating the matter but will probably render its decision very shortly.

The Pacific Power & Light Company, North Yakima, Washington, has announced a cut in gas to consumers using less than 5000 ft. from $1.75 to $1.60 a thousand ft. For consumers using more than 5000 cu. ft. of gas the rate is $1.35 per thousand up to 10,000 with 10 per cent off and the rate is 85 cents a thousand with ten per cent reduction for any amount in excess of 10,000 ft.

The city council of Puyallup, Washington, is seeking a lower rate on electric lighting. The contention is made that a rate of 10 cents a kilowatt with a minimum charge of $1.00 a month is too high. It has been decided to refer the matter to the public service commission for decision.

TRADE NOTES.

The Olympic Portland Cement Company of Bellingham, Washington, recently placed an order through the Westinghouse Electric & Manufacturing Company at Seattle for a three-phase, 220 volt, 6 ton mine type locomotive. Same is equipped with two 15 h.p. motors and two trolleys with track return.

The Globe Electric Company, dealers in wholesale electrical supplies now located at 406 Fourth avenue, will move about the middle of the month to 902 Western avenue in order to have larger and more convenient quarters.

NePage, McKenney & Company, electrical contractors, Seattle, report that their firm has the contract for wiring the Christian Science church recently constructed in Seattle, the Central school building in Tacoma, the 15-story Weart building in Vancouver, B. C., and for alterations on the Arcade building at Seattle. The jobs approximate $3000, $8000, $18,000 and $5000 respectively.

EXAMINATION FOR DEPUTY INSPECTOR OF ELECTRICITY.

On April 17, 1913, there will be held at the City Hall, Portland, Oregon, an examination for Deputy Inspector of Electricity; salary, $100 per month.

Any man 21 years of age and a citizen of the United States is eligible to take this examination if he is also a practical electrician, qualified to pass upon the safety and efficiency of wiring and appliances. The examination will be graded and marked on the following basis:

Electricity: Theory and practice of the use of electricity in buildings for light and power will count 10 points.

Electrical Wiring and Apparatus: The requirements of the ordinances for the installation of electrical wiring and apparatus will count 40 points.

Practical Questions: Details of wiring and the installation of electrical apparatus will count 50 points.

BOOK REVIEWS.

Gas Power. By C. F. Hirshfeld, M. M. E., and T. C. Ulbricht, M. M. E. Size, 5½ x 7½ in.; 209 pages; 60 illustrations; cloth binding. Published by John Wiley & Sons of New York, and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price, $1.25.

The authors, who are respectively professor and instructor at Sibley College, Cornell University, have endeavored to give the reader such knowledge of the methods and facts of gas power as may enable him to appreciate the present commercial status of this branch of engineering. The treatment is simple and non-mathematical and is hence an excellent book for manual training schools and other institutions devoted to industrial education. For electrical men who desire to obtain a first knowledge of gas power principles the book, too, should prove of great value. The internal combustion engine now threatening to enter the coast field of activity may thus be seen in its elements.

INDUSTRIAL

A SOCKET THAT LOCKS.

"Shurlock," the socket that locks, is a simple device recently put on the market by Pass & Seymour to prevent the unauthorized removal of lamps or reflectors from fixtures. This not only protects from theft but also from the use of

A New Lamp Protector.

heating appliances on hotel circuits, and furthermore holds the lamp so that it cannot jar out.

The lamp is held in place by a recessed screw which can be removed only by a special key sold only to responsible parties.

WESTERN ELECTRIC 1913 FANS.

The pressed steel fans, brought out last year by the Western Electric Company, met with such marked approval and covered the field so thoroughly that it was not found necessary to make any changes in design for the 1913 season.

A few additional types have been made, however, chief among which are the 8-inch induction type and the 16-inch residence type fans. The 8-inch induction type was added to meet a demand for this type of fan. It is made for 50 and 60 cycle frequencies from 100-110, 111-120 and 200-230 volts, and is furnished in the regular standard finishes to which has been added a new white nickel finish in which the 8-inch series fans are also furnished. White nickel is especially adaptable for doctors' and dentists' offices, barber shops, hospitals and for use in connection with bathroom fixtures.

A complete new line of 16-inch residence fans has been added for operation on standard voltages and from 25-30, 40 and 50 cycle frequencies. The 12-inch residence line of fans has been extended to include 25-30, 40 and 50 cycle frequencies and standard voltages.

The 32-inch ceiling fans have also been extended to include 25-30, 40 and 50 cycle frequencies, thus placing the Western Electric Company in a position to offer a full line of small size alternating current ceiling fans. One standard finish—black enamel—has been adopted for all desk and bracket type fans.

NEW CATALOGUES.

Bulletin No. A4092 has just been issued by the General Electric Company, describing its Type I-10 Thomson Watthour Meter.

Bulletin No. 8 from the Weston Electrical Instrument Company is devoted to Miniature Precision Direct Current Instruments for both switchboard and portable use.

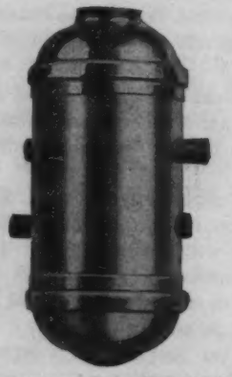
The Engineering Department of the National Electric Lamp Association has issued Bulletin 11A on Mazda Street Series Lamps, giving data on their properties and characteristics.

Under date of March, 1913, the Cutler-Hammer Manufacturing Company of Milwaukee has issued Bulletin 8650, which illustrates and lists all of the C-H push button switches, attachment plugs, receptacles, cord connectors, sockets and plates. This Bulletin 8650 supercedes one of the same number published in January, 1912. A number of new devices are listed and the size of the Bulletin increased.

Bulletin No. 61, "Characteristics and Limitations of the Series Transformer," by H. R. Woodrow and A. R. Anderson, has just been issued by the Engineering Experiment Station of the University of Illinois. This bulletin presents the results of a theoretical investigation of the characteristics and limitations of the series transformers more particularly in connection with its use in recording transient currents. Copies of Bulletin No. 61 may be obtained upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

NEW CUTLER-HAMMER TWO-CIRCUIT SWITCH.

For controlling two groups of lamps in a large cluster or chandelier two-circuit pendent switches are used extensively. Also for fan electroliers where the fan and the lamps may be used at different times, the two-circuit pendent affords convenient control. The lamps or the fan may be operated independently, which is often desirable, as the fan may be needed during the day, when the lighting of the lamps would not be necessary. The Cutler-Hammer Manufacturing Company of Milwaukee has added to its porcelain type a brass shell two-circuit pendent, as shown in the illustration.



Cutler-Hammer Two-Circuit Switch.

The small, quick-break twin mechanisms used in this switch are mounted in a single composition base. Each mechanism is operated by its own push bar, which has a light button at one end and a dark one at the other. The pushing of the light one closes the circuit, while pressure on the dark button opens the circuit.

The switch is of neat design and the mechanism so arranged as to make the operation most convenient. Grasping the switch places the thumb in position to easily operate the push bars. The rating is 6 amperes, 125 volts; 3 amperes, 250 volts, and the approval of the Underwriters' Laboratories has been obtained for this switch, each one bearing the Underwriters' label.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

RECOMMENDATIONS FOR ELECTRICAL INSTALLATIONS IN WOOD WORKING PLANTS, MANUFACTURING PLANTS, WAREHOUSES, PACKING HOUSES. CANNERIES, MINING PLANTS, ETC.

COMPILED BY F. D. WEBER.[1]

(Continued)

14. Sockets. In damp or wet places weather-proof sockets must be used. They must be hung by separate stranded rubber-covered wires not smaller than No. 14 B. & S. gauge, which should preferably be twisted together when the pendant is over three feet long. These wires must be soldered direct to the circuit wires but supported independently of them by knobs. (Rule 31b.)

In dry places stranded brewery cord or packing house portable cord and keyless brass sockets may be used.

The lamp globe in all cases must be protected by an approved wire guard.

In rooms where inflammable gases may exist the incandescent lamp and socket must be enclosed in a vapor-tight globe. (Rule 31a.)

Rosettes should never be used.

Key sockets must not be used. (Rule 31c.)

15. Control Switches for Drop Lights. Drop lights should be controlled by switches, placed in the branch cabinets, or wall switches conveniently located. Snap switches must not be used unless enclosed in dust or moisture-proof cabinets. Knife switches, if exposed to dust, must be placed in cabinets, and if exposed to moisture must be placed in a moisture-proof cabinet or be mounted on porcelain knobs. (Rule 19c.)

16. Portable Lamps. Where long drop cords or portable lamps are necessary the cord must be of the reinforced portable type (preferably what is known as packing house portable cord), and the lamp must be provided with a good substantial guard. (Rule 32d and 54, Section c, Division 2.) The best practice is to use a detachable portable extension made of the portable cord specified above,. with an attachment plug and a lamp provided with a good substantial guard with wooden handle and hook on tip.

When lights must be suspended over the work, in lumber mills, planing mills, etc., make an inverted trough of 1 in. lumber, painted white on inside, and support the wire on the inside of the trough. Wooden moulding will not be approved for use with this trough. The connection between the trough and the rest of the system should be made with a stranded rubber covered wire, properly dead-ended.

17. Arc Lamps. Each lamp must be protected by an approved double pole cutout and each arc should be preferably on a separate circuit. Must be supplied with globes and protected by spark arrester ahd have wire netting around the globe, the mesh not exceeding 1½ in. (Rule 33a to d.)

For Open Knob and Cleat Work.

18. Cabinets must be substantially constructed. If of wood use well seasoned lumber. The door must hinge from the top in order that it may be self-closing, close against a rabbet and be provided with a substantial catch. The bottom must have a slope of 45 degrees to prevent the accumulation of any foreign material. The cabinet must be well painted with moisture proof paint and then lined with asbestos board at least one-eighth inch thick, same to be securely tacked in place and the whole to be well painted. The door must be lined the same as the cabinet. (Rule 70.)

Iron cabinets only will be sanctioned with metal conduit, and are recommended for use with knob and tube work, as they are more durable and generally better constructed. (Rule 70.) These must also have doors hinged at top and have the door overlap sides and bottom of cabinet, making the hinged part of door also dust tight. The bottom must have a slope of 45 degrees to prevent the accumulation of any foreign material.

19. Insulating Supports and Bushings. Wires must be supported at least 4½ ft. by single wire cleats or knobs. (Never use two-wire cleats, as dust or mositure is liable to collect between the two parts and may cause a short circuit.) Wires passing through walls, timbers or floors should be kept from contact with woodwork by porcelain insulating tubes, which must be long enough to bush the entire length of the hole in one continuous piece. (Rule 16, Sections d and e.) Bushings through floors should extend at least one inch above the floor in order to prevent dust and sweepings from collecting in the tubes. The tubes should be protected from mechanical injury by a suitable protecting box of wood or approved metal conduit.

20. Protection to Wires. Where wires run on low ceilings, on walls or partitions or supporting posts, or close to belts, pulleys, etc., they must be protected from mechanical injury. (Rule 20e.) Adequate protection on low ceilings is secured by wooden guard strips placed on each side of and one inch from the wires. These strips should be at least one inch thick and two inches high. Wires must never be run from timber to timber. A good substantial running board, preferably a 2x6 in., must be put up and the wires knobbed to the under side, and then guard strips put up in addition if the wires are exposed to mechanical injury. And if wires are exposed to excessive moisture, guard strips and running boards should be put up forming an inverted trough to protect the wires from the same.

Suitable protection on walls, partitions and vertical timbers may be obtained by substantial boxing enclosing the wires, same to extend not less than seven feet from the floor. Boxing should be closed at the top to keep out dust, etc., the wires passing through bushed holes. Wires must have at least an inch separation from the inside of the boxing.

Instead of guard strips or boxing, wires may be run in approved metal conduit installed according to (Rules 27 and 28, N. E. C.)

Wires must be rubber-covered, unless run in open dry places, and then slow-burning wire may be used. (Rule 28, Sections g and i.)

For Conduit Work.

22. Cabinets must be constructed of steel or iron and be of approved make. (See Division 18 of this pamphlet.)

23. Conduit must be well supported with pipe straps. All elbows or bends must be made so that the enameling or coating will not be injured. Ends must be well reamed. Where entering cabinets or outlet boxes must be provided with a lock nut and bushing. The lock nut must be screwed up tight in order to make a good electrical connection as well as mechanical. Where wires leave the end of the conduit the conduit must always be provided with a condulet or outlet box, the wires passing out through separate holes bushed with porcelain. Drop cords may pass through a bushed hole in the top of the outlet box and then knotted on the inside. All lengths of conduit must be permanently and effectively grounded. The ground wire must make good electrical connection with the conduit. (Rules 27c and 28f.)

24. Wires used with metal conduit must be double braid rubber covered. (Rule 56.)

[1]Electrical Inspector for Underwriters' Equitable Rating Bureau, Portland, Ore.

Outside Wiring.

25. Aerial Construction must be so placed that moisture cannot form a cross-connection, between wires, and except when run in conduit, not less than a foot apart, and not in contact with any substance other than their insulating supports. Wooden blocks to which insulators are attached must be covered over their entire surface with at least two coats of waterproof paint.

For conduit work, wires must be placed so as to conform to rules for unlined conduit except that conduit system must be waterproof. (Rule 12a to h.)

26. Lighting Over Platforms. If the lighting is to be over platforms, tramways, etc., it is much better to run the wires underneath the same. Wires to be supported at least every 10 ft. by petticoat insulators of glass. Branch wires or taps from main wires up to lamp sockets should be run in continuous lengths of approved metal conduit, extending from the under side of the platform up a good substantial lamp post. The lower end of the conduit (under the platform) must be equipped with a condulet or an outlet box, the wires passing through separate insulated holes. The upper end must be bent downward, forming an inverted "U," in order that the moisture cannot enter the conduit, and the end equipped with a condulet, or the weatherproof socket must screw directly to the conduit.

Also, open wiring may be used if same is thoroughly protected from mechanical injury. (See Division 20 of this pamphlet.)

27. Branch Circuits. The lights may be controlled from cabinets underneath the platforms.

28. Wires must be rubber covered or weatherproof, except in the conduit mentioned in Section 26, where double braid rubber-covered wires must be used. (Rules 12a and 56.)

29. Sockets must be weatherproof.

30. Arc Lamps must meet the requirements for arcs mentioned in Section 33.

31. Cabinets must meet requirements specified in Section 70 of the National Electrical Code, and Divisions 18 and 22 of this pamphlet, and in addition must be waterproof.

Motors and Motor Wiring.

32. Motors when operating at a potential of 550 volts or less must be thoroughly insulated from the ground wherever feasible. (Rule 8a.) This can most always be accomplished by a good substantial wooden base frame. Enclose the motor in a dust-proof room when direct current motors or motors with sparking contacts, are used. Such enclosures should be readily accessible, dust proof and sufficiently ventilated to prevent an excessive rise of temperature. The sides should be made largely of glass so the motor may be always plainly visible.

For "high tension" motor installation see "Wiring Data

Oil Transformers.

6a. Must not be placed inside of any buildings except central stations and substations, unless by special permission of the inspection department having jurisdiction. (Rule 36a.)

When permitted inside buildings under Rule 14, N. E. C., must be located as near as possible to the point at which the primary wires enter building. (Rule 45a.)

Must be placed in an enclosure constructed of fire-resisting material; enclosures to be used only for this purpose, to be securely locked, and access only allowed to responsible parties. (Rule 45b.)

Must be thoroughly insulated from the ground or permanently and effectually grounded, and the enclosure in which they are placed must be practically air tight, except that it may be thoroughly ventilated to the outdoor air, if possible through a chimney or flue; there should be at least 6 in. air space on all sides of the transformer. (Rule 45c.)

In order to obtain the approval required of the inspection department, as stated above, transformers must be safeguarded by resting on concrete of at least three (3) in. in depth; be placed immediately under the sidewalk if possible, in an enclosure which must be ventilated by an opening at least six (6) in. square through the sidewalk or to chimney or flue; the fire-resisting material used in constructing the enclosure in which the transformer is located, and by which it is effectually cut off from the remaining part of the basement, must consist of a brick or concrete wall at least eight (8) in. in thickness and have no communication into rest of building unless access is obtained through an approved fire door. The transformer room so constructed must be supplied with sill, to prevent the flow of oil into the basement in case of explosion.

As an alternative to the above construction, the transformer may be placed in a tight steel tank, ventilated to the street and standing on concrete.

(To be continued.)

CALIFORNIA ELECTRICAL CONTRACTORS' CONVENTION

The fourth annual convention of the California State Electrical Contractors' Association, will be held at Santa Barbara, August 13, 14, 15 and 16, 1913, headquarters being established at the Hotel Potter. Arrangements are already underway which assure the success of this meeting and a large and esthusiastic attendance is anticipated. In addition to an excellent program of papers, to be announced later, an elaborate entertainment is planned and a great Jovian Rejuvenation will be conducted under the auspices of the various California Statesmen. The following committees have been appointed, the first-named being chairman in each case:

Committee of Arrangements.

J. C. Rendler, J. S. Reynolds, F. Neilson, C. Loveday, W. S. Hanbridge

Finance Committee.

C. Loveday, G. Arbogast, W. S. Hanbridge

Reception Committee.

J. S. Reynolds, F. Neilson, R. Smith, C. Loveday

Ladies Reception Committee.

Mrs. J. S. Reynolds, Mrs. F. Neilson, Mrs. C. Loveday, Mrs. R. Smith

Boosters' Committee.

Mr. and Mrs. C. V. Schneider, Sacramento.
Mr. and Mrs. L. Youdel, Stockton.
Mr. and Mrs. F. Somers, San Jose.
Mr. and Mrs. W. Thomas, Petaluma.
Mr. and Mrs. C. F. Butte, San Francisco.
Mr. and Mrs. E. C. Wakeland, Oakland.
Mr. and Mrs. H. Lewis, Fresno.
Mr. and Mrs. J. Endert, Bakersfield.
Mr. and Mrs. M. Phillips, Ventura.
Mr. and Mrs. G. Arbogast, Los Angeles.
Mr. and Mrs. H. Miller, Pasadena.
Mr. and Mrs. C. Heilbron, San Diego.
Mr. and Mrs. H. Ross, Riverside.
Mr. and Mrs. E. F. Burkhart, Palo Alto.
Mr. and Mrs. E. Granger, Pomona.

Entertainment of Ladies and Visitors.

Arthur Rowe. He to select his own assistants.

Banquet Committee.

C. Loveday, W. A. McNally, R. Farrell

Picnic Committee and Sports.

R. Smith, F. Neilson, G. Arbogast, L. Gans

Prize Committee.

L. Levy, J. S. Reynolds, J. C. Rendler

Music and Printing Committee.

F. Neilson, J. S. Reynolds, C. Loveday

Transportation Committee.

W. S. Hanbridge, J. S. Reynolds, J. C. Rendler

Rejuvenation, Sons of Jove, Committee.

A. H. Halloran, T. E. Bibbins, S. E. Sanderson, R. B. Clapp, M. Steel, A. Rowe, C. V. Schneider

Convention Papers Committee.

H. Miller, C. F. Butte, F. Neilson

NEWS NOTES

INCORPORATIONS.

TACOMA, WASH.—The Tacoma Electrical Machinery Company has recently been incorporated with a capitalization of $20,000 with J. C. Hill as president; J. W. Holmes, secretary, and W. D. Ludwick, treasurer, and with offices and shop at 759 South D street.

GRANTS PASS, ORE.—The Rogue River Public Service Corporation, a company composed of the creditors of the Chicago-Rogue River Company, bankrupt, has been organized to take over the latter named company and also the Oregon Water & Power Company and the Golden Drift Mining Company. It is the purpose of the new company to consolidate the properties of the above-named companies and to pay creditors 20 per cent of their claim in cash and give first mortgage bonds of the new corporation for the balance. The object is to go ahead with the irrigation and power business on a large scale and to build two more power plants and construct about 50 miles of irrigation ditches and for that purpose the company has authorized a bond issue of $1,000,000 of which issue they expect to sell $600,000 par value for development purposes and use $400,000 to pay off old bonds, claimants, and clear the property except for the bond issue. The officers are George E. Sanders, president; F. A. Fauvre, vice-president; Ovanda C. Beebe, treasurer; George W. Soranson, secretary, and Robert E. Gaut, consulting engineer.

ILLUMINATION.

SODA SPRINGS, IDAHO.—The Utah Power & Light Company has applied for a franchise here.

EPHRATA, WASH.—This city will have a municipal lighting system installed this spring at a cost of $10,000.

UNION, ORE.—Green Bros., Spokane, have offered to install a city lighting plant and accept city bonds in payment.

WHITE SALMON, WASH.—It is rumored that the Northwestern Electric Company will build a plant on the power site recently purchased on White Salmon River above Husum falls.

NELSON, B. C.—David Walmsley, director of the Waneta Development Company, states that $75,000 will be expended on the power plant at the junction of Salmon River and Pend Oreille River.

UNION, ORE.—The city council has taken up the proposition of Green Bros. of Spokane, to install a municipal lighting plant for the city at a cost of $72,000, according to plans and specifications of F. S. Kelsey of Portland.

VENICE, CAL.—The board of trustees has awarded the contract for the installation of a street lighting system, consisting of concrete lamp posts, and galvanized pipe conduits, to the Coast Electric & Machinery Company, for $14,940.

SAN BERNARDINO, CAL.—C. M. Grow, manager of the Southern California Gas Company, has announced that work will be commenced on April 5th on the laying of the high pressure gas main from the company's central plant at Colton to Loma Linda to give that community gas service.

OAKLAND, CAL.—Application was made to the city council for a franchise by the Great Western Power Company for permission to erect, construct and operate wires, poles, and lay conduits for the purpose of transmitting electricity to certain parts of the city of Oakland. Sealed bids will be received up to May 2 for the sale of said franchise to the highest bidder.

TACOMA, WASH.—The St. Paul & Tacoma Lumber Company will install a steam turbine generator current to operate the entire plant. A capacity of 1350 horsepower will be had. Waste wood that otherwise would be burned in the refuse burner will be used to develop the power. The company will also build an addition to its machine shops at a cost of $1000. A considerable amount of new repair tools will be bought.

ESCONDIDO, CAL.—That the Escondido Light & Power Company should present more data regarding its plans for installation of lighting and power plant was the ruling of State Railroad Commissioner Max Thelan, after hearing its application for permission to sell $49,500 shares of its capital stock for the purpose of realizing money for putting in the plant. The hearing was adjourned to some later date, to be announced by the commissioner.

LOS ANGELES, CAL.—Plans for lighting of Long Beach boulevard from Huntington Park to the ocean front, a distance of approximately 15 miles, as proposed at a banquet held not long ago in Cudahy city, is in the hands of a committee which has actively undertaken the project. It is understood that ample funds will be forthcoming to finance the enterprise. Victor G. Kleinberger has been appointed chairman of the committee on plans, and others named are: R. L. Bisby, secretary of the Long Beach Chamber of Commerce; S. M. Burbank and J. H. Keifer of Bells.

SAN FRANCISCO, CAL.—City Attorney Long has addressed Chief Nixon of the Department of Electricity that lighting companies have the right to make service connections of their systems where such are asked for, provided such extensions do not have to be more than 100 ft. long, and that no effort shall subsequently be made to make another connection with the first extension with the idea of so carrying the system on indefinitely, 100 ft. at a time. This right only applies, the attorney explains, to extensions to be made from main service lines in use prior to the going into effect of the constitutional amendment of October, 1911, providing new regulations for the use of street roadways by public service corporations, and requiring them to obtain permission from the local governing bodies before disturbing streets.

BAKERSFIELD, CAL.—Attorney Frank Short of Fresno, who is representing the Bakersfield Gas & Electric Company in the suit filed by that company to have the ordinance fixing a maximum of 50c per 1000 for gas set aside, has signed a stipulation with City Attorney Laird to the effect that a temporary injunction may be issued preventing the ordinance from going into effect, and that all moneys collected by the gas company in excess of the rate fixed by the ordinance shall be impounded in the First National Bank until the case is decided. The stipulation also gives the city until May 1 to answer the complaint in equity which the gas company has filed in the Federal Circuit Court at Los Angeles. The injunction will be issued by Federal Judge Olin Welborn. Meantime the gas company will give receipts to gas consumers showing the amounts they have paid in excess of the rate fixed by the city and these receipts will be good for the difference in case the courts eventually uphold the ordinance. Meantime also, the city will gather such data as may be needed to support the claim that the ordinance is not confiscatory, as the gas company claims.

TRANSMISSION.

JUNEAU, ALASKA.—The Gastineua Mining Company will build by force account a dam on Salmon River this year to develop 3000 h.p.

TOLEDO, ORE.—The Independent Electric Company, a subsidiary of the Washington-Oregon corporation, has applied to the commissioners for a power line between here and Winlock.

BURNABY, B. C.—Superintendent Wm. McNeill of the Western Canada Power Company, states that the power line across Burnaby to the north arm of the Fraser River and Lulu island is contemplated.

IDAHO FALLS, IDAHO.—The Utah Light & Power Company have asked for a franchise and annulment of connection with the Idaho Power & Traction Company, whose business they have recently purchased.

CALDWELL, IDAHO.—The Idaho-Oregon Light & Power Company are securing right of way for the construction of a power line from the Swan Falls plant on Snake River to the pumping plant of the Gem Irrigation District.

MONTESANO, WASH.—W. L. Hawkes, manager, states that the headworks of the plant of the Northwest Electric & Water Works will be relocated and completed at the head of Sylvia Creek. The water mains and light wires will be extended.

BELLINGHAM, WASH.—Henry W. Grant has filed with the county auditor a claim to the use of some 25,000 cu. ft. per second of the waters of Baker River. According to the claims that have been filed it is the plan to construct a dam in the stream at each of the sites filed upon and to build a short distance from the dam a power plant which will develop power for distribution to various other localities.

LOS ANGELES, CAL.—Officers of the Dixie Queen Mining Company have filed notice with the board of public works that land to be used in the construction of the San Francisquito canyon power plant No. 1 of the aqueduct power plant system, has been filed on for more than ten years by that company for mining claims, and that the company will fight all efforts to use the same for power plant purposes.

PORT ANGELES, CAL.—The Olympic Power Company at Port Angeles, Washington, has laid about 9000 ft. of submarine cable across Hoods canal from Port Ludlow to Port Gamble. A 1500 3-phase, 13,200 volt cable furnished by the United States Steele Products Company of Seattle was installed. The cable is peculiar in that it has not a lead cover and was furnished in one continuous piece. It is immersed at one point to a depth of 350 ft. Transformer substations have been provided at the shore ends, stepping down from 66,000 to 13,200 volts at the north bank, raising again to 66,000 volts at the south bank and continuing on to Bremerton.

PORTLAND, ORE.—At the Northwestern Electric Company's White Salmon power house, 75 miles from Portland, the water was turned into the reservoir and one of the units of the great hydroelectric plant was given its first test. The machinery ran very smoothly. The company has the largest wood stave pipe line in the world, the inside measurement being 13 ft, 6 in. Poles have been raised from the plant to Camas, 22 miles from Portland, and the wires are now being strung. The company will soon be ready to supply power to the Crown-Columbia paper mills at Camas. It is expected that construction work will be sufficiently advanced by September 1 to enable the company to distribute power in Portland.

San Francisco, Cal.—The leading feature of the annual meeting of the Pacific Gas and Electric Company on April 8 was the annual reports presented by General Manager Britton and Treasurer Hockenbeamer upon the activities of the company for the year ending December 31. Under the head of statistics the report shows nine hydroelectric power plants in operation, with with a total installation of 90,227 h. p. To this may be added four steam electric plants in operation in the four big cities of the company's territory—San Francisco, Oakland, San Jose and Sacramento—with a total generating capacity of 94,100 h. p. The number of consumers of electricity is given as 116,666. The statistics from the gas department show the number of gas plants in operation by the company as 17, including plants in the principal cities of the territory covered by the company's system. The number of gas consumers in 1912 was 196,133, and the total amount of gas sold, 6,691,072,400 cubic feet. From the water department the figures show 8071 water consumers during the year. The company's system includes a reservoir capacity of 2,472,509,500 cubic feet. The company operates the electric street railway in Sacramento, which has a total mileage of 40 miles, operates 62 cars, and in the last year carried 11,926,098 passengers. In addition, the company supplies 11 other electric railway systems with power for operating purposes, with a total mileage of 594. In the report presented by Second Vice-President and Treasurer Hockenbeamer he showed that in the seven years since the organization of the company it had expended $31,415,232 for plant additions. During the same period the total par value of its outstanding bonds has increased $23,200,000, indicating the creation of an equity for the bondholders of the company in excess of $8,000,000. During 1912 $1,014,000 of the bonds were retired through the operation of sinking funds, making the total so retired to December 31, 1912, $6,167,000. Since 1907 the company's annual taxes have increased from $247,000 to $622,000.

TRANSPORTATION.

VALLEJO, CAL.—The Northern Electric Railroad Company is preparing to erect large warehouses here.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will proceed immediately to electrify the Mount Hood steam line from Gresham to the Mount Hood plant on the Bull Run River, a distance of 22½ miles. This work was decided on after a tour of inspection, this week, by the officials of the company.

SAN FRANCISCO, CAL.—The board of public works has authorized Secretary Churchill to advertise for proposals, to be opened April 16, for building the extension of the Municipal Railway from Thirty-third avenue and Geary street to the ocean, via Thirty-third avenue, Balboa street, Forty-fifth avenue, Cabrillo street and the Great Highway.

MARTINEZ, CAL.—The Oakland & Antioch Railway, through its subsidiary corporation, the San Ramon Valley road, has awarded the contract for the building of the electric line from Walnut Creek to Danville, seven miles, to Palmer, McBride & Quayle. Work will start at once and will be rushed in order that the line may be in operation by July 1.

LONG BEACH, CAL.—A permit has been granted by the board of public works to the Pacific Electric Company to begin repairs on its tracks on Pine avenue, and a large force of men will be put to work at once. Besides Pine avenue, from Sixth street to Ocean avenue, Pacific avenue, and First street, will also be repaired. The cost of the proposed repairing will cost about $70,000.

SAN FRANCISCO, CAL.—There will be a system of 12 tracks in the Transportation building at the Exposition with strength to carry locomotives with axle loads of 60,000 lbs. There will also be tracks to carry lighter exhibits, such as railway coaches and other equipment. Over half of the area of the building will be devoted to equipment of tracks, the remainder of the building being given to railway devices and safety equipment.

SAN FRANCISCO, CAL.—General Manager Black of the United Railroads told the public utilities committee of the supervisors that his company could not undertake to build any extension of its lines under the existing charter conditions. This statement was in response to a request that the United Railroads extend its Brannan street track along First street to the Mail dock, a distance estimated at about 550 ft. Manager Black said this extension would cost from $7000 to $10,000 and would be a source of expense for maintenance without bringing in any additional revenue, while every dollar that the company could spare was needed for the reconstruction of tracks and pavements which had been ordered by the supervisors.